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JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

State of Montana

Project W-120-R-8 Name Statewide Wildlife Research

Study No. BG-1.00 Title Statewide Deer Research

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INTRODUCTION

In 1975 a statewide deer research program was initiated in Montana. Broadly, the objectives of this program were to:

1. Provide a more detailed understanding of the population biology and habitat relationships of deer and of the factors limiting deer numbers in the diverse environments in which deer occur in Montana;

2. Develop new or improved methods for measuring deer population and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs; and

3. Establish new guidelines for consideration of the habitat requirements and relationships of deer in other game, range, forest, and land management programs and practices in Montana.

The study entails concurrent, comparative investigations on the population ecology and habitat relationships of both mule deer and white-tailed deer in all of the major ecological or broad habitat types on which the two species occur. It includes both descriptive and evaluative research. The former is required to provide essential baseline information concerning deer behavior, habitat requirements and relationships, to clarify existing knowledge, and to develop hypotheses concerning the environmental requirements and relations of deer. The study also involves efforts to promote, assist in, and generally coordinate more extensive and pilot deer management studies across the State, and to draw together and relate findings of these studies to those of more intensive investigations and to the overall study objectives.

Current deer studies are located on the accompanying map of Montana (Fig. A). Solid circles denote deer research study areas from which findings are included in this report. Open circles denote management and other special study locations. Those inscribed with a T are management studies involving only deer population trend and classification measurements to date, though more intensive effort may be planned. Completely open circles denote studies which may also involve tagging and marking, or monitoring radio-collared deer, food and range use habits, and/or other habitat relations. Circles inscribed with an X denote special studies conducted by the Ecological Services Division of the Fish and Game Department and other agencies. The latter include the Decker Deer Study conducted by the U. S. Fish and Wildlife Service and deer studies in Glacier National Park.

Findings from management surveys and investigations are reported independently in Montana Department of Fish and Game Regional Progress Reports and as other special progress reports from the Ecological Services Division or the Agency concerned.

The studies reported in this document required the efforts of numerous individuals, both within the Montana Department of Fish and Game and in other agencies. The cooperation of personnel of the U. S. Forest Service, Bureau of Land Management and the U. S. Fish and Wildlife Service, C. M. Russell Wildlife Range, has been especially appreciated. Without their combined interest and effort this study would not be possible.

Cover photo by Terry N. Lonner.

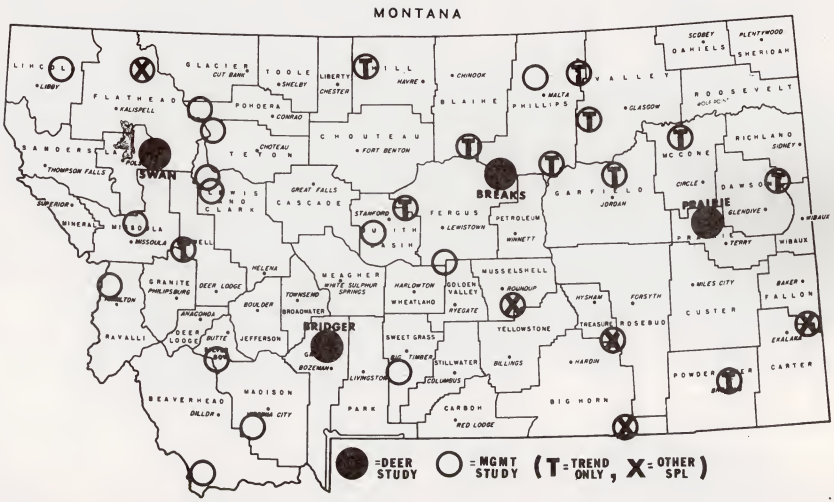

Figure A. Current deer studies in Montana.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

Studies, initiated in November 1975, to evaluate factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the Swan River Valley, Montana, were continued during 1976-77. Sex, age, weight, and body measurement of harvested deer were collected at checking station during the 1976 hunting season. Five marked deer were harvested and reported, from a minimum sample of 76 marked white-tails known to be alive during the hunting season. Distribution of hunting pressure and harvest is discussed. Population parameters were determined from a harvest sample of 104 deer, a road-kill sample of 31 deer, a trapping sample of 80 deer, and observations of 3,743 deer. Fawns comprised 21 percent of the harvest during the either-sex portion of the season and 12 percent of the total harvest. Fawns comprised 32, 41, and 29 percent of the road-kill, trapping, and winter classification samples, respectively. Yearlings represented 41, 6, and 19 percent, respectively, of the harvest, road-kill, and trapping samples. Reproductive tracts were collected from 17 female deer. No pregnant fawns were observed. Fetal and ovulation rates of 2½-year-old-and-older does were 1.5 and 1.7 per doe, respectively. Patterns of reproductive suppression, determined from a sample of marked does, are discussed. Winter observations of deer typically occurred in mixed stands of timber, dominated by Douglas fir *(Pseudotsuga menziesii)*, western larch *(Larix occidentalis)* , and lodgepole pine *(Pinus contorta)*. Several habitat types apparently were represented. Use of natural openings and clearcuts was minor. However, edges of natural openings and certain clearcuts consistently were used. Browse was the dominant forage class and the importance of a variety of species was indicated. Winter home range areas of marked deer averaged 80 acres, similar to that observed in 1976. Home ranges of radio-equipped deer were larger in 1977, compared with 1976. Patterns of summer dispersal, determined for nine radio-equipped deer during each of the two years, are discussed. Summering areas of individual deer were typified by an interspersion of mature coniferous timber with natural openings and wet sites.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

JOB OBJECTIVE: To determine the environmental requirements of white-tailed deer and factors regulating white-tailed deer populations in the coniferous forest habitat of northwestern Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in northwestern Montana.

To develop new and improved guidelines for management of northwestern Montana white-tail populations and their habitats.

INTRODUCTION:

A study to evaluate the factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the coniferous forest habitat of northwestern Montana was initiated in November 1975. This study is one phase of a statewide deer research effort to provide more detailed information on the biology and ecological relationships of deer and to provide new and improved guidelines and methods for deer management.

This study continued to emphasize data basic to the distribution, movements, habitat use, and population dynamics of two white-tailed deer populations during FY-77. This report summarizes information about the deer population which winters in the upper Swan River Valley. Information concerning the herd which winters at Salmon Lake is presented elsewhere (Janke 1977).

STUDY AREA

The upper Swan River Valley extends from Swan Lake south to the Swan-Clearwater Divide. The valley lies between the Swan Mountains to the east and the Mission Mountains to the west. The valley is bisected by the Swan River and by Highway 209 which parallels the river. Most of the winter range in the upper valley lies between Goat Creek and Condon. Condon is approximately 65 miles southeast of Kalispell. A description of this area was presented by Hildebrand (1971). The history of game populations in the Swan Valley and summaries of the early studies are included in Weckwerth (1958), Hildebrand (1971), and Mundinger (1976).

METHODS

Hunting Season

A part-time checking station was operated during the 1976 hunting season. Hunters were interviewed to determine hunter origin, drainages hunted, time hunted, and animals observed. Locations of animals harvested were plotted on a map, as accurately as possible. Ages of white-tailed deer, mule deer *(Odocoileus hemionus)*, and elk *(Cervus canadensis)* were determined by criteria of eruption and wear of the teeth of the lower jaw (Severinghaus 1949; Robinette et al. 1957; Quimby and Gaab 1957). First incisors were collected from deer, for analysis of annuli in the cementum layer (Gilbert 1966). Weights and measurements of deer also were collected.

Distribution and Movements

All observations of deer were plotted according to the legal description of the location. A general description of the surrounding habitat also was made. Animals were classified according to age. Attempts were made to classify adult deer according to sex. Because large numbers of deer were not observed until the bucks had dropped their antlers, these data were not reliable. Additional information resulted from the relocation of animals marked for individual recognition.

Migratory patterns and summer range use data were determined by radio-telemetry. Radio-equipped deer frequently were relocated from a fixed-wing aircraft. This information was supplemented with ground relocations of these animals and reconnaissance of areas used.

Food Habits

Food habits were determined by rumen analysis. Thirty-one one-quart rumen samples were collected from road-killed deer and trap casualties. Rumen contents were examined according to the techniques described by Wilkins (1957). Analysis of these data followed the aggregate percentage method described by Martin et al. (1946).

Vegetation

Permanent browse transects were established during spring 1976 (Mundinger 1976). During fall 1976 all current growth leaders on tagged plants on these transects were counted. A sample of leaders on each plant was tagged and the diameter and length of each was measured. A sample of 100 leaders was clipped from untagged plants. Twig diameter and length, and green and dry weights were determined. These data will be used to estimate browse production of western serviceberry *(Amelanchier alnifolia)* and mountain maple *(Acer glabrum)* on these transects. Analysis of these data has not been completed at this time. The majority of leader tags was lost during the winter. Therefore, the percentage of browse utilization, relative to production, could not be determined.

RESULTS AND DISCUSSION

Hunting Season

The 1976 hunting season in the Swan Valley extended from 24 October until 28 November. Either-sex deer and elk hunting was permitted until 31 October. Thereafter, only bucks and bulls were legal. The season bag limit was one deer and one elk. Hunting conditions generally were poor because a snow cover was present only during the last week-end of the season. A checking station was operated daily during the either-sex portion of the season and on week-ends thereafter.

During the season 3,317 hunters were interviewed. Totals of 104 white-tailed deer, 15 mule deer and 29 elk were examined. According to the 1976 hunter questionnaire, the Swan Valley, Hunting Districts 130 and 131, provided 18,720 man-days of deer hunting and 14,886 man-days of elk hunting. The indicated harvest was 523 white-tailed deer, 94 mule deer, 24 deer of unknown species, and 125 elk. The deer hunter success was 17 percent.

Five marked deer were harvested and reported. Of these, two were recorded at the checking station, two were reported to Department offices, and one was unofficially reported by another hunter after the close of the season. A minimum of 76 marked deer left the winter range in the spring 1976. Population estimates were derived from this marked animal sample, the number of animals checked and the questionnaire harvest estimate (Overton and Davis 1969). These ranged from 4,000 to 7,900. The maximum harvest rate was 13 percent, assuming a population of 4,000 and a total harvest of 523 white-tailed deer. Although several factors preclude giving high reliability to these estimates, they nevertheless, demonstrate that a small proportion of the 1976 standing crop was harvested, and that the 1976 harvest rate was less than half of the 1976 recruitment rate.

Age data were obtained from 92 white-tailed deer. This information is presented and compared with earlier records in Table 1. As compared with 1975, the proportion of fawns in the harvest decreased and the proportion of yearlings increased. Fewer fawns in the 1976 harvest reflected both the more restrictive season and the large proportion of yearlings. Two-and-one-half-year-old deer were well represented in the 1976 harvest. This year-class also was prominent during 1975. There was a decline in the proportion of deer in the older age-classes.

Seventy-four deer were weighed during 1976. These data are listed in Table 2 in comparison with data presented by Hildebrand (1971) and similar data gathered during 1975.

The distribution of hunting pressure and harvest during the 1976 season is presented in Table 3. The greatest proportion of the hunting pressure occurred in that section of the valley between Squaw Creek and the Van Lake Road, and more than half of the hunting pressure occurred in those sections between North Lost Creek and Dog Creek. The origin of hunters was a major factor influencing this distribution. Those interviewed were almost

Table 1. Percent composition, by age-class, of the white-tailed deer harvest from the Swan River Valley, 1957-1976.

Year	Age-class 1/2	1 1/2	2 1/2	3 1/3	4+	Sample Size
1957	30	14	14	17	25	164
1958	18	47	6	12	17	68
1959	21	18	16	7	38	57
1962	23	36	14	9	18	22
1969	31	26	14	15	14	78
1975	21	26	14	13	26	62
1976	13	46	21	10	11	94

exclusively from Flathead and Lake Counties. There appeared to be a relationship between the availability of elk and the distribution of hunting pressure within Hunting District 130, however, the availability of elk in Hunting District 131 apparently did not attract additional hunters. Hunting pressure was not responsive to the availability of white-tailed deer. Disproportionate numbers of deer, relative to hunting pressure, were taken south of Condon Creek in Hunting District 130 and south of Elk Creek in Hunting District 131.

A comparison of the white-tailed deer harvest distribution during 1976 and previous years is presented in Table 4. Weckwerth (1958) indicated that the majority of the white-tailed deer harvest in the Swan Valley occurred in Goat Creek and Lion Creek, included in that portion of the valley between Squaw Creek and Dog Creek. Prior to the intensive logging which began in the early 1960's, the only access roads were in Goat Creek and Lion Creek (Weckweth Pers. Comm.). Since that time, all of the major drainages in the Swan Valley have been well accessed. This change was reflected in changes in the harvest distribution. Noteworthy were a reduction in the proportion of the harvest from Squaw Creek to Dog Creek, increases in the proportion of the harvest from the southern portions of both hunting districts, and a broader distribution of the harvest. The tendency toward an increase in the proportion of the harvest from Hunting District 131 also is consistent with trends in the hunter questionnaire data.

Table 2. Average hog-dressed weights, in pounds, of white-tailed deer harvested in the Swan River Valley during 1969, 1975, and 1976.

Age-class	Male Weights				Female Weights			
	1969	1975	1976	Ave.	1969	1975	1976	Ave.
1/2	66(10)[1]	63(4)	65(5)	65	61(7)	60(4)	63(2)	61
1 1/2	115(10)	119(7)	111(23)	113	108(2)	90(1)	95(10)	97
2 1/2	161(3)	160(5)	146(15)	151	116(3)	103(2)	108(3)	110
3 1/2	163(4)	150(4)	186(7)	170	118(3)	110(3)	125(1)	116
4 1/2	182(5)	178(2)	180(4)	181		115(1)	115(2)	115
5+	175(3)	193(6)	200(2)	189		105(2)		105

[1]Sample size in parentheses.

Table 3. Distribution of hunting pressure and harvest, by drainage, as determined from checking station interviews, during the 1976 hunting season.

Drainage	Hunting Parties	W-T Deer	Mule Deer	Elk
Bear Creek-Johnson Creek	107(7)[1]	5(5)		
6 Mile Creek-Bond Creek	61(4)	3(3)		1(3)
West Swan Lake	124(8)	5(5)	2(13)	1(3)
North and South Lost Creeks	153(10)	7(7)	4(27)	3(9)
Cilly Creek-Soup Creek	236(16)	5(5)		2(6)
Squaw Creek-Van Lake	283(19)	13(13)	1(7)	10(31)
Lion Creek-Dog Creek	117(8)	8(8)	4(27)	
Condon Creek-Smith Creek	95(6)	18(18)	2(13)	
Cooney Creek-Owl Creek	54(4)	10(10)	1(7)	2(6)
subtotal H.D. 130	1,230(82)	74(73)	14(93)	19(59)
Woodward Creek-Fatty Creek	61(4)	1(1)	1(7)	6(19)
Piper Creek-Cold Creek	129(9)	10(10)		3(9)
Elk Creek-Kraft Creek	59(4)	12(12)		3(9)
Lindbergh Lake-Beaver Creek	17(1)	4(4)		1(3)
subtotal H.D. 131	266(18)	27(27)	1(7)	13(41)
Total	1,496	101	15	32

[1]Percentages of the total in parentheses.

Table 4. Comparison of the percentage of the white-tailed deer harvest, by drainage, from checking station data, 1948-1976.

	1948[1]	1949[1]	1957[1]	1958[1]	1959[1]	1962[2]	1975[2]	1976[2]
Sample size	48	51	255	196	196	39	91	101
Drainage								
East Swan Lake	27	18	4	8	3	8	9	8
West Swan Lake				2	5	3	2	5
North and South Lost Creeks		4	6	5	1	8	7	7
Cilly Creek-Soup Creek	4	6	7	4	7	8	8	5
Squaw Creek-Van Lake	31	31	21	19	32	21	22	13
Lion Creek-Dog Creek	23	16	22	13	25	15	8	8
Condon Creek-Smith Creek	4	2	5	11	5	10	22	18
Cooney Creek-Owl Creek	8	10	18	14	9	13	6	10
Subtotal H.D. 130	98	86	82	76	87	85	82	73
Woodward Creek-Fatty Creek	2	12	5	6	9	3	4	1
Piper Creek-Cold Creek			4	8	1	3	9	10
Elk Creek-Kraft Creek		2	4	2	1	10	4	12
Lindbergh Lake-Beaver Creek			4	8	2			4
Subtotal H.D. 131	2	14	18	24	13	15	18	27

[1]Data summarized from two checking stations.
[2]Data summarized from lower Swan checking station only.

A summary of the annual hunter questionnaire data for Hunting Districts 130 and 131 is presented in Figure 1. During the period covered, 1956-1976, the hunting regulations were similar, with the exception of the more restrictive seasons in 1975 and 1976. Conclusions based solely on these data are made with caution due to the variability in the data and to changes in the methods by which they were derived.

The most distinguishing aspects of the deer harvest data are the large annual fluctuations and the lack of a distinct trend. Significant decreases in the harvest were recorded in 1960, 1969, 1971, and 1974. Correct interpretation of these decreases is difficult because of the significant increases which were recorded in 1961, 1968, and 1972.

The number of hunters increased substantially in 1971. Further increases were recorded thereafter. The trend in hunter numbers closely follows that of the harvest during 1963-69. However, there are no apparent statistical relationships between these parameters. The trend in hunter success appears to be inversely related to the trend in hunter numbers.

Changes in the total harvest were reflected in corresponding changes in the total numbers of antlered and antlerless deer in the harvest. There are, however, no apparent statistical relationships between the total harvest and the percentage of antlerless animals in the harvest.

The trend in the harvest closely follows that of the fawn/adult ratio recorded during the previous spring with the exception of 1958. There is an apparent statistical relationship between these parameters ($p = 0.10$), and the relationship is highly significant if the 1958 data are excluded ($p < 0.005$). Decreases in the harvest were associated with a mean fawn/adult ratio of 43.7 (s.e. = 3.6) and increases were associated with a mean fawn/adult ratio of 50.3 (s.e. = 5.0). These data suggest a strong relationship between recruitment, i.e. the proportion of yearling animals in the herd, and total harvest.

Productivity

Data gathered during the 1976 hunting season indicated that the yearling segment of the population was proportionally larger during 1976-77, as compared with 1975-76. Twelve of 22 (55 percent) adult females, 31 of 70 (44 percent) adult males, 43 of 92 (47 percent) total adults and 41 percent of the total white-tailed deer harvested were yearlings. Respective percentages during the 1975 season were 20, 39, 33, and 26. An increased proportion of yearlings probably reflected more an increased rate of fawn survival during the previous winter, rather than a higher rate of production during 1975-76.

The information regarding yearlings also suggested a bias toward this age-class in the checking station data. Forty-seven percent of the adults harvested were yearlings, whereas classification data obtained during winter 1976 indicated that this year-class comprised 28 percent of the adult population.

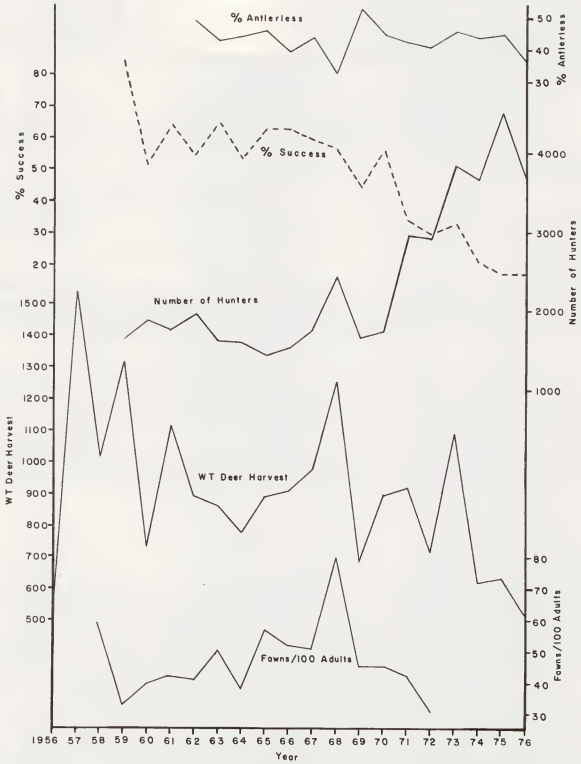

Figure 1. A summary of the annual hunter questionnaire data for Hunting Districts 130 and 131.

Fawn/adult and fawn/doe ratios recorded during the either-sex portion of the hunting season were 27/100 and 55/100, respectively. Corresponding values during the 1975 season were 45/100 and 87/100. However, this indicated decrease in the rate of production was not consistent with other estimates. The ratio of adult females/adult males was 100/100, as compared with 107/100 recorded in 1975.

Classifications of road-kill and trapped deer samples are included in Tables 5 and 6, respectively. Both samples indicated a greater rate of production during 1976-77, as compared with 1975-76. Yearlings comprised a larger percentage of the trapping sample and a smaller percentage of the road-kill sample during 1976-77.

Table 5. Sex and age classification of 31 white-tailed deer in the 1977 sample of road-killed deer.

Sex	Fawn	Yearling	Adult
Female	6	1	13
Male	3	1	6
Uncl.	1		
Total	10	2	19

10 fawns/21 adults - 48 ff/100 adults or 32% fawns	(32/100 and 24%)[1]
10 fawns/14 adult females = 71 ff/100 adult females	(64/100)
2 yearlings of 21 adults = 10% yearlings	(23%)
14 adult females/7 adult males = 200 adult females/100 adult males	(157/100

[1]Comparable 1976 data in parentheses.

Table 6. Sex and age classification of 80 white-tailed deer in the 1977 sample of trapped deer.

Sex	Fawn	Yearling	Adult
Female	17	10[1]	30[2]
Male	16[3]	5[4]	2
Total	33	15	32

33 ff/47 adults = 70 ff/100 adults or 41% fawns	(64/100 and 39%)[5]
33 ff/40 adult females = 83 ff/100 adult females	(78/100)
10 yearling females of 40 adult females = 25% yearlings	(14%)
15 yearlings of 47 adults = 32% yearlings	(17%)

[1]Sample includes recaptures of 2 deer marked in 1976.

[2]Sample includes recaptures of 4 deer marked in 1976 and 3 trap casualties.

[3]Sample includes 1 trap casualty.

[4]Sample includes 1 deer marked in 1976.

[5]Comparable 1976 data are presented in parentheses. Data presented in the 1976 progress report were adjusted to exclude those deer captured with the cannon-net.

Observations of 3,743 white-tailed deer were made during January-April 1977. Of these 3,439 were classified according to age-class (Table 7). The indicated fawn/adult ratio was 41.6/100, or a population comprised of 29.4 percent fawns. Statistically, the rates of fawn production and/or survival were similar during 1975-76 and 1976-77. However, a higher recruitment rate was implied for 1976-77, because non-productive yearling segment of the herd was proportionally larger that year. The 1976-77 classification data are compared with that observed in prior years in Table 8.

A sample of 285 white-tailed deer was observed during the six replications of the upper Swan Valley trend route. Recruitment estimates derived from this sample were in very close agreement with those derived from the much larger sample observed throughout the winter (Table 7).

Table 7. Monthly classifications of white-tailed deer in the upper Swan River Valley during the winter, 1977.

Month	Total	Classified	Adults	Fawns	Uncl.	ff/100 Ad.	% ff.	% Uncl.
January	103	95	69	26	8	38	27.4	7.8
February	1,024	931	636	295	93	46	31.7	9.1
low[1]		30	25	5		20		
high[2]		73	46	27		59		
March	2,476	2,282	1,636	646	194	39	28.3	7.8
low		103	79	24		30		
high		50	32	18		56		
April	140	131	88	43	9	49	32.8	6.4
1977 Total	3,743	3,439	2,429	1,010	304	42	29.4	8.1
Trend Route	285	270	191	79	15	41	29.3	5.3
1976 Total	2,269	2,119	1,519	600	150	39	28.3	6.6

[1]Daily classification with the lowest fawn/adult ratio during the month.

[2]Daily classification with the highest fawn/adult ratio during the month.

Table 8. White-tailed deer fawn/adult ratios in the Swan River Valley, 1958-1977.

Year	Adults	Fawns	Fawns/ 100 adults	Percent Fawns
1958	167	99	59	37
1959	207	68	33	25
1960	77	30	39	28
1961	19	8	42	30
1962	80	33	41	29
1963	59	31	53	34
1964	234	90	38	28
1965	188	108	57	36
1966	33	17	52	34
1967	51	26	51	34
1968	30	26	80	46
1969	122	55	45	31
1970	249	112	45	31
1971	66	28	42	30
1972	42	13	31	24
1976	1,519	600	39	28
1977	2,429	1,010	42	29

Fawn/adult ratios, observed within different drainages, are presented in Table 9. Difficulties associated with this information involve a clear definition of herd unit boundaries and the selection of an appropriate time period in which to make the comparative estimates of production. The data suggest that productivity varied between different herd segments. Further, annual variation within segments may not have been consistent with the annual variation evidenced by the herd as a whole.

A summary of the data collected from the sample of reproductive tracts is included in Table 10. No pregnant fawns were examined. Twelve of 13 (92 percent) adult females were pregnant. Only one yearling doe was examined. Fetal and ovulation rates for older does were 1.5 and 1.7 per doe, respectively. The potential reproductive status of this herd, determined from 1970 (Hildebrand 1971), 1976, and 1977 collections, is summarized in Table 11. Hildebrand (1971) indicated that the *in utero* productivity of the upper Swan Valley herd was less than that reported for other white-tailed and mule deer populations.

Information obtained from collared females permits further insight to the reproductive performance of the upper Swan Valley herd. The reproductive status was estimated from field observations for 16 marked adult does during 1976 and 32 marked adult does in 1977. Of these, 11 and 16, respectively, were observed with fawns. Because observations were made in winter and early spring, the term "reproductive success" implies that fawns were successfully reared to the age of 8 months. Most, if not all, of the fawns in this sample also were successfully recruited into the adult population.

Productivity of marked does, by age-class, is presented in Table 12. These data are a pooled sample from 1976 and 1977. Several does are included twice in this sample, once during each winter in the respective age-classes. No marked yearlings successfully reared fawns. This observation was consistent with the lack of pregnant fawns in the collection of reproductive tracts (Table 11). Few of the 2½-year-old-does, females bred as yearlings, were observed with fawns (Table 12). This contrasts with the 100 percent pregnancy rate observed in this age-class (Table 11). The reproductive performance of the 3½-year-old-does suggested that productivity also was suppressed in this age-class (Table 12). The highest percentage of successful does was observed in the 4½-year-old age-class. However, none of the does in this group was observed with twin fawns. This contrasts with the observation that *in utero* productivity is highest in the 3½-year-old age-class (Table 11). The rate of reproductive success by the 5+-year-old-does was less than that observed for the 4½-year-old-does. However, the net productivity per doe was similar, due to the success of twin fawn litters (Table 12).

The reproductive performance of nine adult does was estimated during both winters (Table 13). Three of these deer successfully reared fawns during 1975-76 and again in 1976-77. Five does were successful in one year, but not in the other. One doe was a reproductive failure both years. This information suggested that a tendency toward breeding success only in alternate years exists in this herd.

Table 9. Fawn/adult ratios by drainage, on the upper Swan River Valley winter range.

Drainage	Jan.-Feb. 1976	Mar.-Apr. 1976	1976	Jan.-Feb. 1977	Mar.-Apr. 1977	1977
Goat Creek	50	35	40	42	28[1]	33[1]
Simmons Creek	36	45	43	49	49[2]	49[2]
Van Lake	36	37	36	42	45[2]	44
Lion Creek	44	39	40	51	40	44
Lower Dog Creek	43	39	40	39	33[1]	35[1]
Upper Dog Creek	--	--	--	48	40	41
Winter Range ave.	44	38	39	46	40	42

[1]0.90 confidence interval for this value less than the winter range average.

[2]0.90 confidence interval for this value greater than the winter range average.

Table 10. Summary of reproductive tract collections.

Age	Date	C. L. of Pregnancy	Embryos	C-R Length (cm)	Weight (gm)
1/2	2/24		0		
1/2	3/10		0		
1/2	3/17		0		
1 1/2	2/3	1	1		
2 1/2	2/3	2	2M		
2 1/2	2/27	2	1M	18.0	142
			1F	18.5	147
2 1/2	3/23	-	1M		
3 1/2	3/1	1	1M	17.0	
3 1/2	3/10	-	1		
3 1/2	3/16	2	1M	23.0	363
			1F	23.0	347
3 1/2	3/23	2	1M	24.0	443
			1F	23.0	466
3 1/2	3/30	2	1F	27.0	746
			1M	27.0	
3 1/2	4/6	2	1M		
			1F		
3 1/2	4/15		Pregnant		
4 1/2	3/22	2	1M	22.0	336
			1M	26.0	546
Old[1]	1/13	2	1		
Old	2/26	0	0		

[1]Deer collected in the lower Swan Valley.

Table 11. Reproductive status, by age-class, as determined from 1970[1], 1976, and 1977 collections of white-tailed does from the Swan Valley.

Age	Sample Size	Percent Pregnant	Fetuses per Doe	Fetuses per Pregnant Doe	Ovulation[2] Rate
1/2	19	0			
1 1/2	8	100	1.1	1.1	1.0
2 1/2	8	88	1.4	1.6	2.0
3 1/2	13	100	1.7	1.7	1.9
4 1/2	9	89	1.6	1.8	2.0
Old	6	83	1.2	1.5	1.5

[1]1970 data from Hildebrand (1971).
[2]Ovulation rates from 1976 and 1977 data only.

Table 12. Reproductive performance, by age-class, of collared does.

Age/ Class	No. of Cases	No. of Successful Does	No. of Fawns	Percent Success	Fawns/100 Does
1½	15	0	0	0	0
2½	8	2	2	25	25
3½	10	4	4	40	40
4½	7[1]	6	6	86	86
5+	23	15	21	65	91

[1]This sample includes two trap casualties.

Table 13. Reproductive performance of 9 adult female white-tailed deer, collared in 1976, based on winter observations.

Deer No.	Number of fawns in 1976	Number of fawns in 1977	Estimated age in 1976
29-76	1 or 2	2	5 1/2
36-76	0	1	3 1/2
41-76	1	1	6 1/2
49-76	1	0	4 1/2
50-76	2	0	5 1/2
55-76	1	1	6 1/2
75-76	1	0	4 1/2
85-76	0	0	2 1/2
86/76	0	2	7 1/2

It should be emphasized that data pertaining to marked deer are preliminary. Limitations which apply to this information include the small sample size, the ability to accurately estimate the age of adult deer while handling them in a trap, and the ability to accurately assess the reproductive status of an individual doe, particularly reproductive failure, from winter field observations.

Despite these limitations, the data clearly demonstrate that the net productivity of this herd is considerably less than its potential and that several factors contribute to this difference. Productivity is suppressed during the first two breeding cycles ($2\frac{1}{2}$- and $3\frac{1}{2}$-year-old-does) due to reproductive failure, and during the third breeding cycle ($4\frac{1}{2}$-year-old-does) by the failure to successfully rear twin fawns. Nutritive failure, as described by Verme (1962), probably is a major factor contributing to these losses. Nutritive failure is further evidenced by the suggested pattern of alternate year reproductive succes. Verme (1967; 1969) described a situation in which reproductive failure, due to nutritive failure, by does on poor winter nutrition, contributed to reproductive success in the following year.

Distribution and Range Use

Observations on the winter distribution of white-tailed deer during 1977 were similar to those described by Hildebrand (1971) and Mundinger (1976). This distribution is depicted in Figure 2.

Within this general distribution, almost all observations of deer occurred within mixed stands of mature timber. Douglas fir *(Pseudotsuga menziesii)*, western larch *(Larix occidentalis)*, and lodgepole pine *(Pinus contorta)*, in various combinations, typically were codominant species in these stands. On some sites ponderosa pine *(Pinus ponderosa)* also was well represented. A preliminary inventory of the upper Swan Valley winter range suggested that the *Abies grandis/Clintonia uniflora* and/or *Abies lasiocarpa/Clintonia uniflora, Picea/Clintonia uniflora,* and *Pseudotsuga menziesii/Calamagrostis rubescens* habitat types (Pfister et al. 1977), were well represented. In these habitat types, Douglas fir, western larch, lodgepole pine, and ponderosa pine are important components of seral communities.

Use of natural openings and clearcuts was minor within that portion of the winter range used both in 1976 and 1977. Typically, use of large openings was limited to single, well established trails between two stands of timber. Hildebrand (1971) suggested that open areas were not available for deer use because of the increased snow depths. Other factors, as well, apparently restrict the use of clearcuts by deer. Snow accumulations were not great or prolonged during 1977, yet there were no indications of greater use of clearcuts by white-tailed deer.

Observations of deer frequently occurred on, or near, the timbered edge of natural openings, potholes and marshes. Typically, a well established trail encircled each of these sites, and several trails connected the site with the surrounding trail system.

Use of the timbered edges of some clearcuts also occurred. However, this use was less predictable than that associated with natural openings. Several factors seemed to determine the suitability of clearcut edges as winter habitat for white-tailed deer. The more important probably related to changes in incident solar radiation and the influence of increased sunlight on the microclimate, snow depths, and forage growth. The presence of a clearcut permits a greater amount of sunlight to penetrate the adjacent stand because there is no canopy which intercepts that radiation with an acute incident angle. Clearcut edges which received consistent use by deer were typified by a south- or west-facing aspect. A few of these sites also were on slopes. Certain east-facing edges also received deer use. However, the influence of greater sunlight on many east-facing clearcut edges is less noticeable because the Swan Mountains intercept much of the morning sunlight.

Certain distributional differences were recorded between 1976 and 1977 (Fig. 2). Cut-over areas on the lower slopes of the Swan Mountains between Smith Creek and Alder Creek and in the vicinity of Squeezer Creek received considerable use by white-tailed deer during February and March 1977. These areas are immediately adjacent to winter range which was occupied during

Figure 2. White-tailed deer winter range boundary in the upper Swan River Valley and the 1977 winter home ranges of 10 radio-equipped deer.

Figure 2. Continued.

both winters. Presumably, deer from these adjacent areas extended their winter home ranges to include these cut-over areas. This may have occurred in response to the unusually mild climatic conditions which prevailed.

Those cut-over areas which received consistent use were typified by a slope with a west or southwest exposure, lack of persistent snow cover, robust shrub growth, particularly serviceberry, mountain maple, and redstem ceanothus *(Ceanothus sanguineus)*, and adjacent mature timber. Often the presence of robust shrubs, scattered leave trees, occasional small patches of Douglas fir, and conifer regeneration provided visual cover within the cut. On wetter sites dense growths of birch *(Betula* spp.), alder *(Alnus incana)*, and willow *(Salix* spp.) also provided escape cover.

In addition to use by white-tailed deer, the Smith Creek-Alder Creek area was used by elk from January through early April and by mule deer from mid-March through mid-May. During the period of joint occupancy, white-tailed deer used the lower elevations, mule deer were confined to the higher elevations, and elk occurred throughout.

During 1976 white-tailed deer use of clearcuts occurred during a brief period, coincident with spring "green-up". This use was not prominent during 1977. Summer dispersal was well underway before a pronounced "green-up" had occurred.

Food Habits

Winter food habits of white-tailed deer in the upper Swan River Valley were determined by the examination of the contents of 28 rumen samples. Results are presented in Table 14 and compared with similar data collected during 1976. Data for 1976 were changed from those previously reported (Mundinger 1976) to include two additional samples. Three samples in the 1977 collection have not yet been analyzed.

Browse, forbs, grasses, and other materials comprised 85, 9, 3, and 2 percent, respectively, of the winter diet during 1977. Comparable values during 1976 were 91, 4, 2, and 3 percent. The browse diet consisted of 25 and 21 percent coniferous species during 1976 and 1977, respectively.

Oregon grape *(Berberis repens)* was the predominant item in the diet during both winters. A variety of other deciduous browse species also was important. Taxa which frequently occurred inlcuded serviceberry, kinikinnik *(Arctostaphylos uva-ursi)*, snowbrush ceanothus *(Ceanothus velutinus)*, willow *(Salix* spp.), and white spiraea *(Spiraea betulifolia)*. These species probably comprised the majority of the unidentified browse category as well. Douglas fir and common juniper *(Juniperus communis)* were the important coniferous species. Twin-flower *(Linnaea borealis)* and beargrass *(Xerophyllum tenax)* were the prevalent forbs. Use of tree-moss *(Allectoria* spp.) was indicated by the presence of this material and/or Western larch bark in the rumen samples. Deer frequently were observed feeding on tree-moss, but the importance of this material in the diet was difficult to evaluate by rumen analysis.

Table 14. Winter food habits of white-tailed deer in the Upper Swan River Valley, as determined by rumen samples.

	December		January		February		March		April		Winter	
	1975	1976	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Taxon	(3)[1]	(4)	(3)	(1)	(4)	(9)	(6)	(10)	(3)	(4)	(19)	(28)
ABGR		0.50[2]/0.6			0.25/ 1.9						0.05/ 0.4	0.07/ 0.1
JUCO	1.0 /20.4	0.50/ 2.2	1.0 /28.5		0.75/ 5.2	0.44/ 0.6	0.50/ 1.8	0.40/ 1.2		0.50/ 4.3	0.63/ 9.4	0.43/ 1.5
LAOC		0.25/ 0.1	0.33/ 1.7			0.11/ 0.1		0.20/ 0.1		0.25/ 1.3	0.05/ 0.3	0.18/ 0.3
PICEA spp.								0.10/ 0.1				0.04/tr[3]
PICO	0.67/ 0.4		1.0 / 2.0		0.75/ 0.4	0.56/ 1.0	0.67/ 1.3	0.70/ 3.6	0.67/ 1.0	0.75/ 0.9	0.74/ 1.0	0.54/ 1.7
PIPO			0.67/ 0.6					0.10/tr			0.11/ 0.1	0.04/tr
PSME	1.0 / 8.5	0.75/ 5.8	1.0 /10.2 -	/11.8	0.75/ 1.9	0.89/28.7	1.0 / 3.8	1.0 /10.4	1.0 /19.4	0.50/tr	0.95/ 7.6	0.86/14.2
THPL					0.25/17.2		0.17/ 0.7	0.10/tr			0.11/ 3.9	0.04/tr
Total Conifer	1.0 /29.3	1.0 / 8.7	1.0 /43.0 -	/11.8	1.0 /26.5	1.0 /30.4	1.0 / 7.0	1.0 /15.4	1.0 /20.4	1.0 / 6.4	1.0 /22.4	1.0 /17.8
ACGL	0.67/ 2.1	0.50/ 0.2	-	/ 0.3		0.11/ 0.1	0.17/tr				0.16/ 0.3	0.14/ 0.1
ALIN	0.67/tr		0.67/tr		0.50/ 0.2	0.11/tr	0.83/ 0.4		1.0 / 0.7		0.74/ 0.3	0.04/tr
AMAL	0.67/ 1.7	0.75/ 0.2	1.0 / 3.2 -	/ 0.5	0.50/ 2.7	0.78/ 4.2	0.67/ 0.6	0.50/ 0.5	1.0 / 5.3	0.50/ 0.2	0.74/ 2.4	0.64/ 1.6
ARUV	1.0 / 4.4		1.0 / 6.9		0.75/ 2.3	0.56/ 1.6	0.33/ 3.8	0.90/ 2.6	0.67/ 2.0	0.75/ 4.0	0.68/ 3.8	0.61/ 2.0
BETULA spp.					0.25/ 0.5	0.56/ 0.2		0.10/tr		0.50/tr	0.05/ 0.1	0.29/ 0.1
BERE	1.0 /27.1	1.0 /49.4	1.0 / 6.7 -	/ 6.1	1.0 /22.5	0.89/37.1	1.0 /80.6	0.90/48.5	1.0 /37.8	1.0 /76.5	1.0 /41.5	0.93/47.5
CESA	0.33/tr		0.67/ 3.5							0.25/tr	0.16/ 0.5	0.04/tr
CEVE	1.0 / 1.7	1.0 / 3.5	0.67/ 2.6		0.75/ 1.7	0.78/ 1.7	0.67/ 0.7	0.20/ 0.2	1.0 / 0.9		0.79/ 1.4	0.46/ 1.1
COST						0.22/ 0.4		0.10/ 0.1		0.25/tr		0.14/ 0.2
HODI		0.25/24.0										0.04/ 3.4
PAMY		0.25/ 0.3			0.25/tr	0.11/tr	0.33/ 0.6		0.67/14.2	0.25/ 0.2	0.26/ 2.4	0.11/ 0.1
RUBUS spp.	0.33/ 0.5		0.33/ 0.1 -	/tr		0.22/ 1.2		0.10/ 0.1			0.11/ 0.1	0.14/ 0.4
ROSA spp.	0.33/tr		0.33/ 0.1 -	/ 1.4		0.44/ 1.3	0.17/tr	0.20/ 0.1			0.16/tr	0.25/ 0.5
SALIX spp.	1.0 / 7.9				0.50/ 1.1	0.22/ 0.3	0.83/ 0.7	0.40/ 0.3	0.33/ 0.4		0.58/ 1.8	0.21/ 0.2
SHCA			0.33/ 0.1		0.25/ 0.2						0.11/ 0.1	
SPBE	1.0 / 0.7		0.33/ 1.6		0.75/ 0.8	0.44/ 0.4	0.50/ 0.2	0.40/ 0.2	0.33/tr		0.58/ 0.6	0.29/ 0.2
SYAL	0.33/ 0.4	0.25/tr	0.33/tr	- /tr		0.11/ 0.8					0.11/ 0.1	0.11/ 0.2
Unid. Browse	1.0 / 7.9	0.25/ 0.2	1.0 /24.8 -	/72.0	0.75/27.8	0.89/16.2	0.67/ 3.7	0.90/ 5.3	0.67/ 6.8	0.25/ 0.6	0.79/12.7	0.71/ 9.8
Total Browse	1.0 /34.4	1.0 /77.8	1.0 /49.6 -	/80.3	1.0 /60.0	1.0 /65.3	1.0 /89.3	1.0 /57.9	1.0 /68.7	1.0 /81.4	1.0 /68.1	1.0 /67.3
Conifer & Browse	1.0 /83.7	1.0 /86.4	1.0 /92.5	1.0/92.1	1.0 /86.6	1.0 /95.7	1.0 /96.3	1.0 /73.3	1.0 /89.2	1.0 /87.9	1.0 /90.5	1.0 /85.1
ADBT		0.50/ 0.1										0.07/tr
ANTENNARIA spp.	0.33/tr											0.05/tr
CHUM	0.33/ 0.1	0.25/ 1.7			0.25/ 0.6	0.11/tr	0.17/ 0.1	0.50/ 0.6		0.25/ 0.1	0.21/ 0.2	0.29/ 0.5
CIRSIUM spp.		0.75/ 3.4		- / 5.3		0.22/tr						0.21/ 0.8
FRVI							0.17/ 0.1			0.25/ 0.1	0.05/tr	0.04/tr
GOOB	0.33/ 2.1										0.05/ 0.3	
LIBO	0.33/tr	0.25/ 1.7			0.25/ 0.3	0.33/ 2.1	0.50/ 0.4	0.80/11.5	0.33/ 0.3	0.75/ 8.9	0.32/ 0.2	0.50/ 6.1
PENSTEMON spp.		0.25/ 0.2										0.04/tr
PIMA									0.33/ 0.3		0.05/tr	
PYROLA spp.								0.20/ 0.1				0.07/tr
TRIFOLIUM spp.								0.30/ 0.1		0.25/tr		0.14/ 0.4
XETE	0.67/ 2.2	0.50/ 1.8		- / 1.5	0.75/ 1.1	0.33/ 0.7	0.86/ 1.8	0.20/ 0.7	0.67/ 6.5		0.63/ 2.2	0.29/ 0.8
Unid. Forbs	1.0 / 0.9	0.75/ 0.5	1.0 / 2.2		0.25/ 2.5	0.44/ 0.4	0.17/ 0.2	0.30/ 0.9	0.67/ 1.5	0.50/ 0.7	0.47/ 1.3	0.43/ 0.6
Total Forbs	1.0 / 5.3	0.75/ 9.8	1.0 / 2.2 -	/ 6.8	1.0 / 4.5	1.0 / 3.3	1.0 / 2.5	1.0 /14.8	1.0 / 8.7	1.0 / 9.7	1.0 / 4.3	0.96/ 9.4
Grasses	0.67/ 9.6				0.25/tr	0.22/ 0.5	0.33/ 0.1	0.70/ 8.0	0.67/ 2.0	0.50/ 0.3	0.37/ 1.9	0.39/ 3.0
ALLECTORIA spp.	0.33/ 0.3	0.25/ 2.3	0.67/ 3.2			0.11/ 0.1	0.17/tr	0.20/ 2.3			0.21/ 0.6	0.14/ 1.2
Larch Berk	0.67/ 0.2	1.0 / 1.2	0.67/ 1.3 -	/ 0.4	0.50/ 6.5	0.33/ 0.2	0.17/ 0.2	0.40/ 1.5		0.50/ 0.3	0.37/ 1.7	0.46/ 0.8
EQUISETUM spp.	0.33/ 0.1					0.11/tr	0.17/tr	0.10/tr		0.25/ 1.8	0.11/tr	0.11/ 0.3
SELAGENELLA spp.			0.33/tr		0.50/ 2.6		0.17/ 0.1			0.50/tr	0.21/ 0.6	0.07/tr
Lichens					0.25/tr	0.22/ 0.1					0.05/tr	0.07/tr
Mushrooms	0.33/ 0.8	0.25/tr	0.67/ 0.8 -	/ 0.7		0.22/ 0.1	0.33/ 0.2	0.10/ 0.1	0.33/ 0.3		0.32/ 0.4	0.14/ 0.1

[1]Sample size in parentheses.
[2]Frequency of occurrence/percentage of the diet.
[3]tr = trace, less than 0.1 percent of the diet.

Table 15. Plant nomenclature used in Table 14.

Abbreviation	Nomenclature	Common Name
Conifers		
ABGR	*Abies grandis*	Grand fir
JUCO	*Juniperus communis*	Common juniper
LAOC	*Larix occidentalis*	Western larch
PICO	*Pinus contorta*	Lodgepole pine
PIPO	*Pinus ponderosa*	Ponderosa pine
PSME	*Pseudotsuga menziesii*	Douglas fir
THPL	*Thuja plicata*	Western red cedar
Shrubs		
ACGL	*Acer glabrum*	Mountain maple
ALIN	*Alnus incana*	Thinleaf alder
AMAL	*Amelanchier alnifolia*	Western serviceberry
ARUV	*Arctostaphylos uva-ursi*	Kinikinnik
BERE	*Berberis repens*	Oregon grape
CESA	*Ceanothus sanguineus*	Redstem ceanothus
CEVE	*Ceanothus velutinus*	Snowbrush ceanothus
COST	*Cornus stolonifera*	Red dogwood
HODI	*Holodiscus discolor*	Mountain spray
PAMY	*Pachistima myrsinites*	Myrtle pachistima
SHCA	*Shepherdia canadensis*	Canadian buffalo-berry
SPBE	*Spiraea betulifolia*	White spiraea
SYAL	*Symphoricarpos albus*	Common snowberry
Forbs		
ADBI	*Adenocaulon bicolor*	Trail-plant
CHUM	*Chimaphila umbellata*	Common pipsissewa
FRVI	*Fragaria virginiana*	Strawberry
GOOB	*Goodyera oblongiflora*	Rattlesnake plantain
LIBO	*Linnaea borealis*	Twin-flower
PLMA	*Plantago major*	Broadleaf plantain
XETE	*Xerophyllum tenax*	Beargrass

Winter food habits observed during 1976 and 1977 generally were consistent with those reported for 1957 (Weckwerth 1958) and 1970 (Hildebrand 1971). Species composition in the diet was similar, except for the lack of snowbrush ceanothus in the 1957 samples. A greater percentage of Oregon grape occurred in the 1976 and 1977 samples, as compared with 1957 and 1970. Bergeson (1943) did not present quantitative food habits data. He did indicate that the majority of food consumed was Douglas fir and tree-moss. Willow, mountain mape, serviceberry, ceanothus (species not indicated), and juniper. Oregon grape, huckleberry *(Vaccinium* spp.) and kinikinnik also were used during periods of reduced snow cover. Present data are consistent with these observations.

Large potential foraging areas have been created by logging, since the 1943 and 1957 studies. Yet, there is no variation in the food habits data that would indicate any significant change in the foraging habits of white-tailed deer. The predominant winter forage items, at least, continue to be those associated with the mature forest community.

Trapping

Presently, 74 marked animals, which are known to be alive, are in the Swan Valley white-tailed deer population. An additional 91 marked deer were not accounted for during the 1976-77 winter but may be in the population. Nineteen marked deer were known mortalities.

One hundred and fifteen white-tailed deer were captured and marked during winter 1976. Of these, 76 were accounted for at the time of spring dispersal, the fate of 36 was unknown, and 3 were known mortalities. The causes of death were 1 possible coyote kill, 1 winter kill, and 1 road-kill. Of the 76 deer which left the winter range, 45 were observed during winter 1977, 20 were not accounted for, 5 were harvested during the 1976 hunting season, one died from an unknown cause during late fall 1976, and 5 were 1977 mortalities. The causes of death were 1 poached, 2 winter kills, and 2 road-kills.

Sixty-nine deer were marked during winter 1977. Of these, 29 were accounted for, 35 were not observed after trapping, and 5 were known mortalities. Causes of death were 1 coyote kill, 1 winter kill, 2 road-kills, and 1 from an unidentified cause during the summer.

Home Range

Relocations of 26 collared deer were sufficient to provide estimates of their respective winter home range areas. The rectangular area which included all observations of each individual was assumed to represent the winter home range. Home range areas ranged from 32 to 253 acres, with a mean of 80 acres (s.e. = 10.4). These values were similar to those recorded during 1976, which ranged from 31 to 220 acres, with a mean of 81 acres. Five deer were included in the samples for both years, but the indicated

changes were not conclusive. Two deer had large increases in home range area, one from 58 to 253 acres, the other from 31 to 202 acres. The home range area of the third deer decreased from 139 to 32 acres. The home ranges of the remaining two deer showed little change.

The probable home range perimeters of 10 radio-equipped deer were plotted on aerial photographs (Fig. 2), and the included areas were calculated. Home range areas for these deer ranged from 90 to 218 acres, with a mean of 150 acres (s.e. = 16.5). Home ranges of four of these deer were calculated during both years. During 1976 these areas ranged from 89 to 141 acres, with a mean of 122 acres; during 1977 they ranged from 187 to 218 acres, with a mean of 207 acres.

Approximations of the winter home ranges of three radio-equipped deer are depicted in Figure 3. Because these are approximations, the indicated areas do not coincide exactly with the above values. The 1977 home ranges included all of the 1976 home range and extensions into adjacent areas. The additional area used by the two deer in Goat Creek, numbers 50-76 and 60-76, was occupied by deer during early winter and early spring both years. However, it did not support deer during mid-winter 1976. Presumably, this area was available to deer in 1977 because of the mild weather conditions that winter. The additional area used by deer 4-76 was occupied by deer during both winters. The additional area used by the fourth deer, not included in the figure, included areas which she had used during early winter and early spring 1976.

Movements

Summer dispersal of radio-equipped deer is presented in Figures 4 through 9. This information was determined from nine deer during 1976. Nine deer, four of which were included in the 1976 sample, also were monitored during 1977.

Deer 4-76 (Fig. 4) was captured as an old adult female in January 1976. She remained in the general vicinity of her trap site, near Van Lake, until mid-April. During May this deer was relocated in Bond Creek and the North Fork of Lost Creek, east of Swan Lake, approximately 15 miles north of her trap site. During June through August this deer could not be located. At that time it was thought that her transmitter had failed. However, during September she was again relocated in the South Fork of Lost Creek. Thereafter, through mid-December she was found in Bond Creek and Groom Creek. She returned to her wintering area, similar to that used in 1976, in early January 1977, and remained there until mid-April. This deer was relocated in late April and May in the South Fork of Los Creek but she could not be found during June through mid-July. In late July and August she was relocated in the vicinity of Lindbergh Lake, approximately 22 miles south of her winter home range, and 33 miles south of the Lost Creek relocations. Presumably, this movement corresponded with the period during 1976 when she could not be located.

Deer 27-76 (Fig. 5) was captured near Van Lake in January 1976, as a $2\frac{1}{2}$-year-old-female. She remained in the vicinity of the trap site until mid-April. During early May through mid-December she was relocated near the

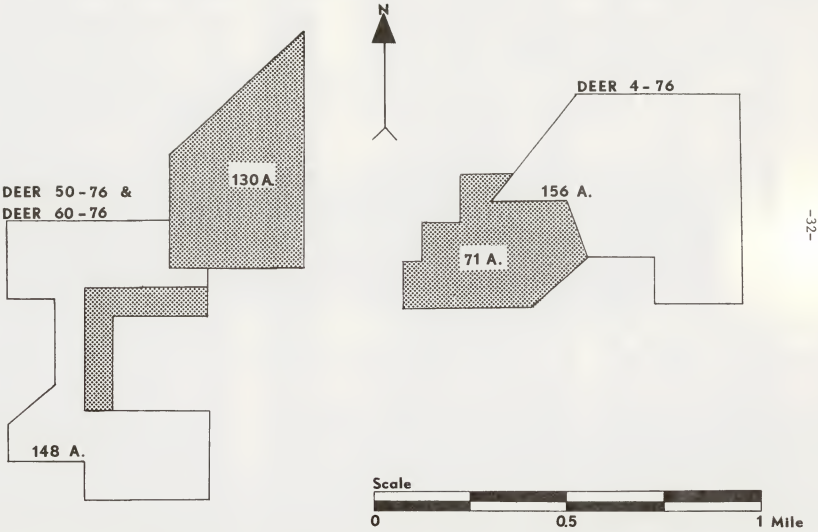

Figure 3. Approximations of the 1976 winter home ranges of 3 radio-equipped deer, with additional areas used during 1977 included in the shaded portions.

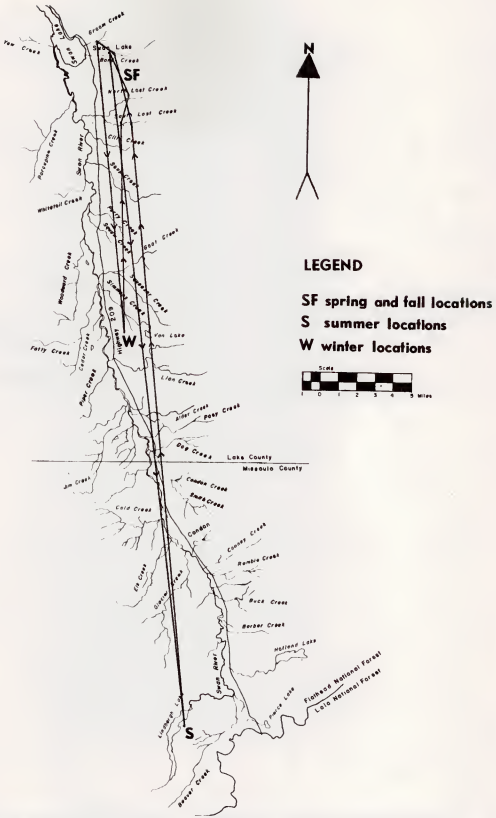

Figure 4. Movements of deer 4-76, as determined from 1976 and 1977 relocations.

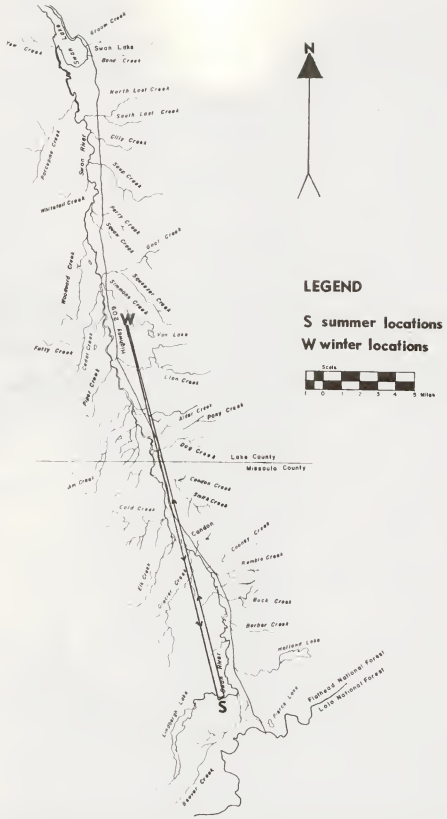

Figure 5. Movements of deer 27-76, as determined from 1976 and 1977 relocations.

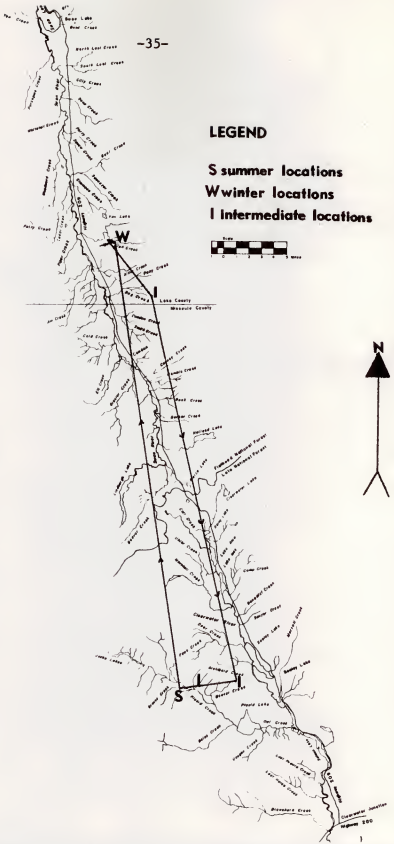

Figure 6. Movements of deer 36-76, as determined from 1976 and 1977 relocations.

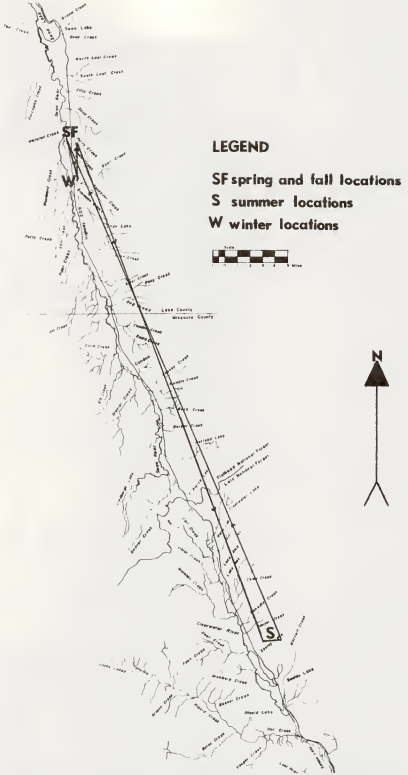

Figure 7. Movements of deer 60-76, as determined from 1976 and 1977 relocations.

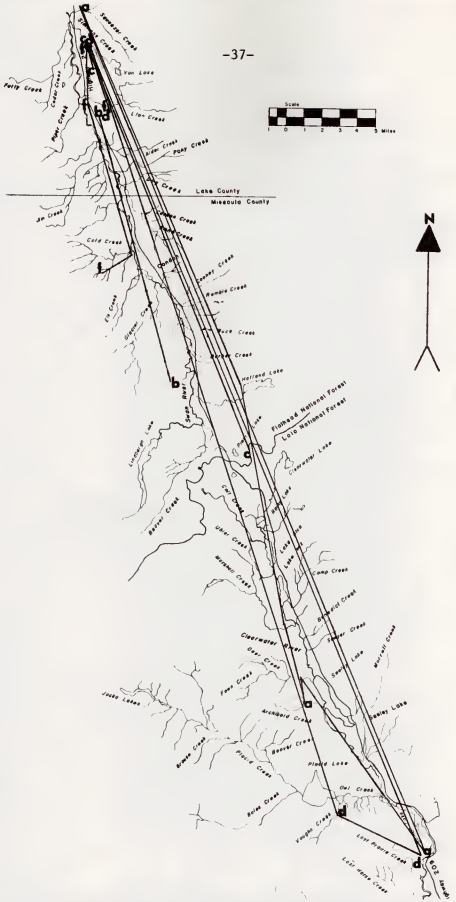

Figure 8. Movements of 5 radio-equipped deer during 1976.

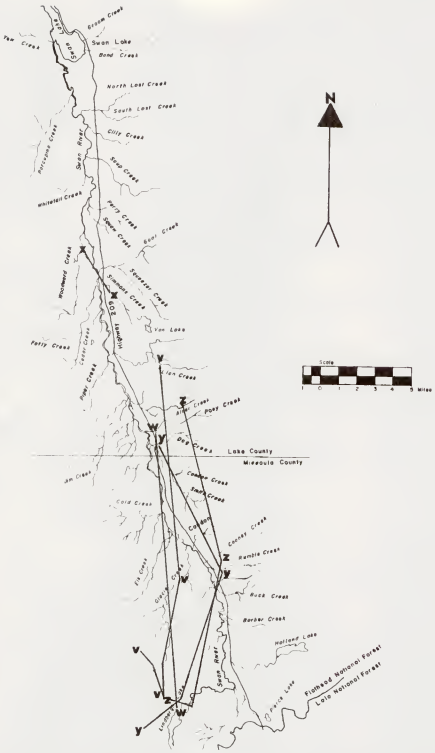

Figure 9. Movements of 5 radio-equipped deer during 1977.

Swan River, approximately 2 miles east of Lindbergh Lake, and approximately 21 miles south of her wintering area. This deer had returned to the winter range by mid-January 1977. She remained in an area similar to that used during 1976 until mid-April. Her summer 1977 movements were similar to those observed during 1976.

Deer 36-76 (Fig. 6) was captured in January 1976 near the Lion Creek Road as a 3½-year-old-female. Following the capture, she moved about 2 miles east and remained in Lion Creek Canyon until early April. She was relocated near the Double Arrow Lookout, west of Seeley Lake, in late May, and in Placid Creek, approximately 35 miles south of her wintering area, during June through mid-November. This deer had returned to Lion Creek Canyon by mid-December. She remained in an area similar to that used during 1976 until early April 1977. By mid-May she had returned to her summering area in Placid Creek. Intermediate relocations were obtained in Dog Creek in mid-April and in Slippery John Creek during late April.

Deer 60-76 (Fig. 7) was captured, as a 4½-year-old-female, near the State Forest Headquarters at Goat Creek, in March 1976. She remained in this area until early April. During mid-April through mid-May she was found in Squaw Creek, approximately 3 miles north of her wintering area. This deer was relocated during June through mid-September in Rice Creek, east of Seeley Lake, approximately 38 miles south of her wintering area and 41 miles south of Squaw Creek. She had returned to Squaw Creek by late September and remained there until mid-December, at which time she returned to Goat Creek. She remained in Goat Creek until early April 1977. Thereafter, her movements recapitulated those observed during April through August 1976.

Deer 50-76 (Deer a in Fig. 8) was captured as an old adult female in Goat Creek in March 1976. She remained in Goat Creek until early April. She was relocated near Holland Lake in early May, in Marshall Creek during late May, in Archibald Creek during late June through early August, and in Fawn Creek through late September. Approximately 39 miles separated her summering and wintering areas. This deer could not be relocated during October through December, however she was observed in mid-December near the Salmon Lake Winter Range (Janke pers. comm.). She returned to her Goat Creek wintering area by late January 1977. This deer died from an undetermined cause during late winter.

Deer 96-76 (Deer b in Fig. 8) was captured, as a 3½-year-old-female, in late March 1976 near the Lion Creek Road. She remained near the trap site for about 2 weeks. During early May through late November she was relocated near the Kraft Creek Road, approximately 15 miles south of her trapsite. This deer died from an undetermined cause during late fall.

Deer 9-76 (Deer c in Fig. 8) was captured, as an old adult female, near Van Lake in January 1976. She moved approximately 1 mile north and spent the winter in Simmons Creek. She had left her wintering area by mid-April. Subsequently, she was relocated in Condon Creek in early May and near Pierce Lake, approximately 22 miles south of Simmons Creek, during late May through June. Thereafter, her transmitter failed. She was observed in early April 1977 within her 1976 wintering area.

Deer 24-76 (Deer d in Fig. 8) was captured, as a 4½-year-old-female, near the Lion Creek Road in January 1976. Subsequently, she moved approximately 4 miles north to Simmons Creek, where she remained until mid-April. She was not relocated until late June. At that time she was in Vaughn Creek, southeast of Placid Lake, approximately 44 miles south of her wintering area. This deer remained in Vaughn Creek until mid-October, at which time her transmitter failed. This deer was observed near the Salmon Lake Winter Range in Mid-December (Janke pers. comm.) and in Simmons Creek in March 1977.

Deer 23-76 (Deer f in Fig. 8) was captured, as a yearling female, near the Lion Creek Road in January 1976. She moved approximately 4 miles north to Simmons Creek, where she remained until mid-March. This deer returned to the vicinity of her trap site during late March through mid-April. During May she was relocated near the junction of Cold Creek and the Swan River. During June through mid-August she was relocated in the South Fork of Cold Creek, approximately 12 miles south of her wintering area, and 4 miles southeast of the mouth of Cold Creek. She has not been relocated since, and it is assumed that her transmitter failed.

Deer 68-76 (Deer v in Fig. 9) was captured, as a male fawn, in Lion Creek Canyon in March 1976. He was recaptured several times during 1977 in Lion Creek Canyon. He was equipped with a transmitter in March. This deer remained in Lion Creek Canyon through early May. During June through August he was relocated at various sites within the Glacier Creek drainage. Unlike the does, which evidenced a fidelity for a particular locality, this deer generally moved between relocations. Red Butte Creek, the approximate midpoint of his summer relocations, is approximately 17 miles south of his wintering area.

Deer 23-77 (Deer w in Fig. 9) was captured, as a 3½-year-old-female, in Pony Creek in early February 1977. She remained in the general vicinity of her trapsite until early May. She was relocated near Lindbergh Lake, approximately 15 miles south of Pony Creek, in early June. Thereafter, she has not been relocated.

Deer 25-77 (Deer x in Fig. 9) was captured, as a yearling female, at Simmons Meadow in early February 1977. She remained near Simmons Meadow until early April. From mid-April through August she was relocated near Metcalf Lake, approximately 3 miles northwest of her wintering area.

Deer 43-77 (Deer y in Fig. 9) was captured, as a 3½-year-old-female, in Dog Creek in early March 1977. She remained in Dog Creek through early April. She was relocated in Rumble Creek in mid-April, near Lindbergh Lake from late April through early June, and in Glacier Creek, approximately 16 miles south of Dog Creek, during late June through mid-July. This deer died from an undetermined cause in late July.

Deer 56-77 (Deer z in Fig. 9) was captured, as a 2½-year-old-female, in mid-March 1977 in Alder Creek. She was relocated in Rumble Creek during mid-April and near Lindbergh Lake during late April through June. In July and August this deer was relocated in Glacier Sloughs, approximately 17 miles south of her trapsite.

Recovery locations of five deer, taken during the 1976 hunting season, are presented in Figure 10.

Summer Range Use

The summer home ranges of the radio-equipped deer suggested certain similarities in range use patterns. Each of the summering areas was typified by a dense timbered overstory. A mixture of coniferous species generally was present within each summer home range, but the species composition was not consistent between sites. A habitat classification of these areas has not been completed. However, several habitat types, within the *Abies grandis*, *Abies lasiocarpa*, *Picea*, and *Pseudotsuga menziesii* series, as described by Pfister et al. (1977), may be represented within the white-tailed deer summer range. Further, a variety of cover types, representing various successional stages of these habitat types, seems to be present. Habitat and cover types probably are less important in determining the summer range of white-tailed deer than the mere presence, or absence, of coniferous cover.

Also consistent between summer home ranges was the presence of small natural openings and wet sites. These typically occurred as creek bottoms, marshy sections of creek bottoms, potholes, marshes, and meadows. The patterns of trail systems indicated that these sites were integral to the individual summering areas.

Recent cut-over areas were included in some of the individual summer home ranges. These areas were used by white-tailed deer, with the greatest use of the cut-over areas apparently confined to the edges. Natural openings and wet sites, from which all adjacent timber has been removed, apparently were not attractive to deer.

The movements of radio-equipped deer suggested distinct summer concentrations of white-tailed deer within the Glacier Creek and Beaver Creek drainages of the Swan River and in the headwaters of the Clearwater River. This observation is consistent with the harvest distribution observed during the 1975 and 1976 hunting seasons, and the higher harvest rates, relative to hunting pressure, within the southern portions of Hunting Districts 130 and 131. An obvious difference between the area near the Swan-Clearwater Divide and the remaining portions of both valleys relates to timber harvest. Recent logging has been more intensive north of Kraft Creek, a tributary of Glacier Creek, and south of Colt Creek.

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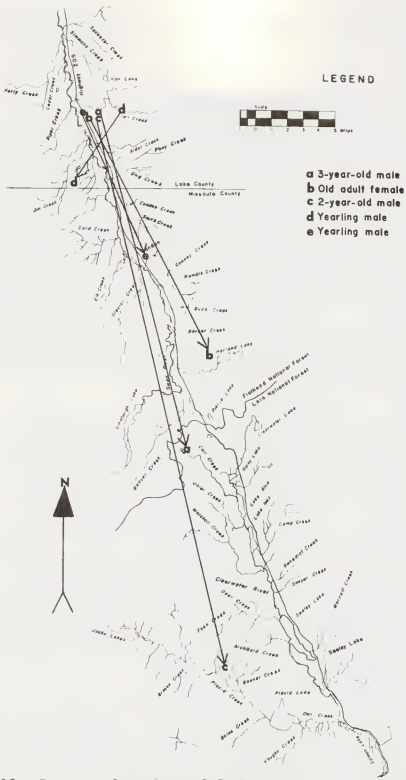

Figure 10. Recovery locations of 5 observation-collared deer during the 1976 hunting season.

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Submitted by: John G. Mundinger

JOB TITLE: White-tailed deer movements, survival, and population characteristics in the Clearwater River Drainage.

JOB OBJECTIVE: The project's primary objectives are to determine the population characteristics of this herd and describe the sites used by deer on this winter range.

INTRODUCTION:

The Salmon Lake area of the Clearwater Drainage in Montana has historically been a heavily used winter range for white-tailed deer. In a time of decreased hunter success and increased claims of coyote predation in Montana, it is necessary to increase our understanding of the biology of deer if they are to be managed properly. Also, the Clearwater Drainage herd concentrates in a small area adjacent to a highway and is easily accessible. For these reasons this is an ideal population to work with in the study of deer biology in Montana.

METHOD

Summer distribution - Summer distribution was checked from the ground and from the air in 1976. The Clearwater Drainage was patrolled systematically, searching for marked deer. Occasionally, animal sightings were obtained from U. S. Forest Service, Burlington Northern, and Blackfoot Cooperative personnel. Locations of radio-collared deer were plotted from the air at monthly intervals through the summer. Monthly aerial-tracking is being conducted this summer, also.

Population Characteristics - Information on hunter harvest and deer physical characteristics was obtained at the Bonner checking station for deer harvested in the Clearwater and Blackfoot drainages.

Sex ratio counts were attempted in December. Age ratio counts were made throughout the winter. Kelker's strip census was used once in mid-winter to provide number/area data.

Several methods were employed in animal condition analysis. The bone marrow compression test and the kidney fat index were used when possible, and deer were weighed when possible. Also, blood collected from cannon-netted deer will be analyzed.

Productivity data were obtained from analysis of reproductive tracts. Urine samples were collected from deer or known sex and reproductive status on the National Bison Range as well as from roadkills, from live does, and from snow in the Salmon Lake area. A sex differentiating test on the urine failed. However, some information on the percent of does pregnant should be obtained from the Asheim-Zondek test results.

SITE SELECTION

Deer locations were determined by backtracking. Sites were defined as points at constant intervals along deer tracks. Snow depth as well as topographic and vegetational characteristics including aspect, percent slope, slope position, cover type, and overstory density were recorded at each site. Information on shrub species present and shrub cover was recorded. Also, information was collected on the instances of use of

various shrub species. Topographic and vegetational characteristics were noted at regular intervals along transects in several habitat types to compare with the same characteristics at sites selected by deer.

FIELD WORK AND THESIS PREPARATION

Last summer's field work involved an average of three days in the field per week, plus one day of aerial-tracking per month. Weekends were devoted to checking station activities in the fall hunting season.

Intensive field work was conducted in the Salmon Lake area January-March, 1977. Summer work at present involves monthly aerial-tracking and thesis preparation. The project's final report will be presented in thesis form by December, 1977.

Submitted by: Doug Janke

Job Title Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

ABSTRACT

A population of approximately 200 mule deer was estimated for the Armstrong Winter Range during April 1977, an increase of about 30 deer (18 percent) from the spring of 1976. Most of the increase was attributed to relatively high fawn survival to and through the exceptionally mild 1976-77 winter; though mortality of adults to hunting and overwinter was also exceptionally low. Only the number of adult males in the population declined, possibly reflecting greater hunting mortality, a relatively high turnover rate among males as compared with females, and a third successive year of low recruitment of yearling males. With continued high overwinter survival, mule deer numbers on the Armstrong Range are within one year's reproduction of those estimated for 1972-73 and 1973-74. Because the increased numbers of deer on the Armstrong Range was abetted by some movement of animals onto the area in the winter of 1975-76, it probably is not indicative of the change in mule deer numbers in the Bridger Mountains as a whole since 1975. Since 1972, only 7.5 percent of 106 deer tagged on the Armstrong Range have been shot by hunters; and an average of only about 3.5 percent of the marked deer available to hunters in any one year were reported shot. Twenty-two percent of all marked deer have died due to other mortality factors, mostly winter kill of fawns and old adults. The ratio of 33 fawns:100 adults was the highest observed ratio for late winter since the study began in 1971-72. No fawns and only two adults were known to have died over the 1976-77 winter. In previous years, fawn mortality has ranged from about 12-15 percent (1975-76) to 85-90 percent (1974-75), with a 5-year average of about 40 percent from early to late winter. Movement patterns of radio-collared deer indicate that movements within and between seasons and years and behavior characteristics of individual animals; and concepts such as migration and home range may have only limited values as parameters or descriptors of habitat usage of the Armstrong population as a whole. Concepts such as winter, intermediate, and summer range can be applied to the population only in the sense that they describe the seasonal limits, or at least concentration areas, of the population; but they are only relative terms when applied to individual deer. Utilization of antelope bitterbrush and big sagebrush on transects was generally low, and similar to or only slightly higher than that for 1975-76.

Job Title — Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

Job Objective — To determine the environmental requirement of mule deer and factors regulating mule deer populations in mountain-foothill habitats of southwestern Montana.

To determine the effects of various potentially competing land use and management practices upon mule deer in southwestern Montana.

To develop new and improved guidelines for management of southwestern Montana mule deer populations and their habitats.

INTRODUCTION

Studies concerning population trends and dynamics and habitat relationships of mule deer in the Bridger Mountain Range have been conducted continuously since 1971. Initially, the effort was directed at (1) obtaining population data for mule deer on winter ranges along the west slope of the Bridger's from Bozeman to Flathead Pass (Fig. 1), with emphasis on the Armstrong Winter Range, (2) a study comparing food habits and range use of mule deer on the Armstrong Range during 1972 (Schwarzkoph 1973) with similar studies 15-years earlier (Wilkins 1957), and (3) a study of ecological characteristics of the Armstrong Winter Range, including production and utilization of preferred browse plants (Bucsis 1974). Hamlin (1974) further discussed summer distribution, movements, and population characteristics of mule deer associated with the Armstrong Range during 1973-74; and Mackie et al. (1976), Pac (1976); and Mackie and Stewart (1976), extended these studies through the spring of 1976. Recently, Morton (1976) reported results of studies of nutritional values of major forage plants on the Armstrong Winter Range during 1974-75 and 1975-76. This report summarizes results of studies conducted on the Armstrong Winter Range during the winter-spring of 1977, with emphasis on population trends and characteristics. Results of two graduate research projects concerning patterns of habitat usage of radio-collared deer on the Armstrong Winter Range and distribution, movements and habitat use of mule deer on the Schafer Creek area in the southern half of the Bridger Mountains (Fig. 1) will be reported separately.

ACKNOWLEDGMENTS

The studies have been conducted with the cooperation and assistance of Montana Department of Fish and Game, Region 3, U. S. Forest Service, Gallatin National Forest, and local landowners including Mrs. Elsie Armstrong, Mr. George Eblin, Mr. Claude Maher, Mr. Lloyd Maher, Mr. Lester Warwood, and Mr. Frank Norman. Murray Duffy, Central Helicopters, and

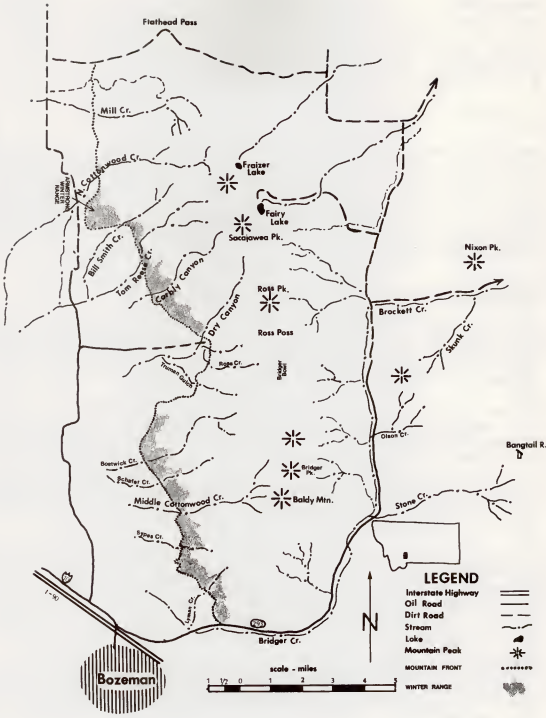

Figure 1. Map of the Bridger Range showing major features and location of the Armstrong Winter Range.

James Stradley, Gallatin Flying Service, both contributed extensively through their flying and observational skills in helicopter and fixed-wing aerial surveys, respectively. Much credit is also due all of the many individual Montana Department of Fish and Game personnel and Montana State University graduate and undergraduate students who have participated in one way or another in the studies.

STUDY AREA

The Bridger Mountain Range is located in northeast Gallatin County, Montana. The Armstrong Winter Range comprises approximately 1,260 acres, along a westerly projecting "toe" of the main Bridger Range approximately 20 miles north of the city of Bozeman (Fig. 1). Topographic, edaphic, climatic, and vegetational characteristics of the area have been described in detail by Bucsis (1974). A habitat type map and list of habitat types on the winter range (after Bucsis 1974) is presented as Figure 2.

METHODS

Mule deer population and range use characteristics were determined primarily through aerial surveys during early and late winter and ground observations associated with deer trapping and other studies on the Armstrong Range during late winter and early spring.

The aerial surveys, employing a Bell 47G 3B-2 helicopter with the same pilot and principal observer as previous years (Mackie et al. 1976), were completed January 5-9 and March 10-11, 1977. Coverage included all mule deer wintering areas along the west slope. Locations, numbers, sex (in early winter) and age (adult or fawn) were recorded for all observations. In early winter, antler classes of males were also recorded. Elevations and habitat types used, as well as numbers, location and identifying markings of collared deer were also recorded.

Ground observations to develop population estimates were recorded during a total of 14 days in April. All mule deer were recorded as to number, age (adult or fawn), whether marked, specific markings, activity, location, habitat type, elevation, slope gradient, and exposure. Groups were recorded collectively, with locations marked precisely on aerial photograph-habitat type maps.

Additional marked deer were obtained by trapping, between January 22 and April 25. Specific trapping methods including the cannon net and a corral type bait trap have been described by Mackie, et al. (1975). In addition, up to seven portable bait traps (Clover 1954) were employed during 1977.

During 1977, a total of 47 mule deer were trapped, including 31 captures of previously marked animals and 16 new (Table 1). Markers were four-inch-wide collars of Armor-tite fabric, color coded using tuff-flex marking paint, and fastened with blind rivets. Radio transmitter collars were fastened to 7 new deer, 4 males and 3 females (see Appendix Table 12). Two transmitters applied in 1975 and four placed on deer in 1976 continued

Figure 2. Aerial view of the Armstrong Winter Range showing habitat types defined by Buscis (1974).

1. *Festuca idahoensis/Agropyron spicatum*
2. *Agropyron spicatum/Agropyron smithii*
3. *Purshia tridentata/Agropyron spicatum*
4. *Purshia tridentata/Artemisia tridentata*
5. *Artemisia tridentata/Festuca idahoensis*
6. *Acer glabrum/Philadelphus lewisii*
7. *Populus tremuloides-Prunus virginiana/Symphoricarpos albus*
8. *Juniperus scopulorum-Purshia tridentata/Artemisia tridentata*
9. *Juniperus scopulorum-Purshia tridentata/Agropyron spicatum*
10. *Juniperus scopulorum-Purshia tridentata/Festuca idahoensis*
11. *Pseudotsuga menziesii/Prunus virginiana*
12. *Pseudotsuga menziesii/Symphoricarpos albus*
13. *Pseudotsuga menziesii/Festuca idahoensis*
14. *Pseudotsuga menziesii/Carex geyeri*

Table 1. Summary of mule deer trapping effort and success on the Armstrong Winter Range, winter of 1976-1977 (January 22-April 25, 1977).

Trap No.	No. Trap Nights	No. Deer[1] Caught	No. Deer/ 100 TN	No. New Deer Tagged
1[2]	83	19	22.9	3
2[3]	70	9	12.8	2
4[4]	49	6	12.2	2
5	51	9	17.6	5
6	27	0	0.0	0
14	8	1	12.5	1
15	8	0	0.0	0
17	9	0	0.0	0
18	32	1	3.1	1
19	8	0	0.0	0
Totals	345	45	13.0	14

[1]Two additional mule deer were tagged using the cannon net.

[2]Maher Corral Trap.

[3]Warwood Corral Trap.

[4]Trap numbers 4-19 were Clover traps.

to function through most of the winter into spring 1977. A new transmitter was placed on one adult male to replace a transmitter which was put on in the spring of 1976 and failed in late summer. As deer left the winter range in early May, radio-collared deer were followed by approximately weekly relocations using receiving equipment from a fixed-wing, Piper Super-cub Aircraft. A summary of mule deer tagged on the Armstrong Winter Range from 1972 through 1977 and their status as of June 1977 is given in Tables 2 and 3.

A systematic "dead deer survey" of the winter range between North Cotton-wood and Bill Smith Creeks was conducted in mid-May. The survey employed project personnel and Montana State University students and followed

Table 2. Summary of mule deer trapped on the Armstrong Winter Range from 1972 through 1977 and their status as of June 1, 1977.

Year	Total No. Marked	No. OK[1] 6/77	No. Dead	No. Left AWR[2]	Unknown[3]
1972	5	1	3(3)[4]	--	1
1973	16	8	5(1)	1[5]	2
1974	39	11	8(1)	1	19
1975	36	15	15(3)	1	5
1976	10	7	1	1	1
1977	16	16	0	0	0
Totals	122	58	32	4	28

[1]Number alive and accounted for on Armstrong Winter Range winter-spring 1977.
[2]Deer known or believed to be wintering elsewhere in 1976-77 only.
[3]Includes at least 11 unreadable-frayed collars on Armstrong Winter Range in 1977 (See Table 3).
[4]No. shot by hunters in parenthesis.
[5]Probable.

Table 3. Years of last observation for currently unknown marked mule deer.

Year Tagged	1972	1973	1974	1975	1976	Total
1972	0	1				1
1973	-	1[1]	1			2
1974	-	-	4	8	7[2]	19[2]
1975	-	-	-	1	4	5
1976	-	-	-	-	1	1
Totals	0	2	5	9	12[2]	28[3]

[1]Last seen summer 1973. One additional animal not previously observed since tagging was believed seen in Truman Gulch in the spring of 1977.
[2]Includes one animal, marked in 1974 and last seen in 1976, whose collar was found at the head of Reese Creek in October 1976.
[3]Includes at least 11 collared deer on Armstrong Winter Range in the spring of 1977 with faded, frayed and otherwise unreadable collars.

procedures similar to those employed in May 1975. Browse utilization transects, 7 on bitterbrush *(Purshia tridentata)* and 5 on big sagebrush *(Artemisia tridentata)*, established by Bucsis (1974), were remeasured in late May. Methods followed those of Bucsis (1974) and included estimates of percentage of current growth twigs utilized and length and weight of current annual growth removed.

RESULTS AND DISCUSSION

The 1976-77 Winter

Monthly weather data and winter severity indices (Picton and Knight 1969) for the Montana State University Weather Station at Bozeman (Table 4) compare November-May conditions from 1971-72 through 1976-77. Although located approximately 15 air miles south of the winter range this station is only slightly lower in elevation and conditions may be reasonably representative of general conditions along the west slope of the Bridger Mountains.

These data indicated that the 1976-77 winter was characterized by relatively mild temperatures and light snowfall, and was generally less severe and prolonged as compared with 1975-76. Overall it also was generally less severe than any preceding winter.

Phenological data, based on lilac bloom dates for the Bozeman area (D. K. Scharff, pers. comm.) are listed in Table 5. These data indicate that plant growth and development during 1977 may have been the earliest in more than 20 years. During 1975 snow melt and plant phenology were approximately 2 weeks behind normal (Pac 1976), and the latest in more than 20 years; while in 1976 "spring" conditions and plant growth were nearly a week ahead of normal.

Population Size and Trend

Population estimates for mule deer using the Armstrong Winter Range during 1976-77 (Table 6) were developed from ground observations during April 1977. The occurrence of many deer in timbered habitat types during January and March aerial surveys precluded accurate identification of all collared deer, and thus the calculation of Lincoln Indices for either period. Ground observations were hampered throughout the winter by mild conditions resulting in a comparatively scattered deer distribution and light usage of observable habitats during daylight hours. Increased use of lower slopes and open habitats with "green-up" in early April provided improved observability.

Cumulative ground, aerial, and trapping records indicated that 58 deer wearing recognizable collars occurred on the winter range by the end of April 1977 (Table 2). In addition, approximately 11 deer wore unrecognizable, frayed or faded collars. Although it is possible that even more animals with unreadable collars occurred (Table 3), this would seem unlikely since most of the remaining 16 deer which could have been present have

Table 4. Climatological data, MSU Weather Station, Bozeman, and severity indices, November through May, 1971-1976.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
November	1971	33.7	0.77	11.2	5	17	- 297
	1972	32.8	0.63	3.0	4	8	- 250
	1973	30.4	1.27	15.8	11	25	+ 104
	1974	35.1	0.67	4.7	2	10	- 377
	1975	30.5	1.33	20.5	12	15	+ 491
	1976	35.5	.20	3.9	4	4	- 415
December	1971	20.8	0.56	11.1	10	31	+1161
	1972	18.6	0.49	12.2	4	23	+1047
	1973	29.5	1.29	20.5	13	16	+ 234
	1974	25.5	1.02	13.2	6	31	+ 284
	1975	30.0	1.10	15.8	6	22	+ 84
	1976	30.3	.22	3.3	3	8	- 232
January	1972	19.1	0.86	13.8	10	31	+1068
	1973	19.2	1.10	16.6	9	31	+1837
	1974	21.3	0.42	5.8	14	25	+3743
	1975	22.8	1.58	22.9	14	31	+1369
	1976	26.6	0.60	8.7	9	28	+ 360
	1977	30.3	.60	13.5	9	31	+ 583
February	1972	31.0	0.66	10.2	6	27	- 75
	1973	24.4	0.04	1.8	8	28	+ 483
	1974	32.0	0.43	7.8	4	21	- 206
	1975	21.3	1.11	19.5	17	28	+1659
	1976	30.4	0.52	9.8	4	5	- 187
	1977	33.8	.06	1.0	3	17	- 322
March	1972	41.0	1.24	13.6	8	8	- 586
	1973	33.9	1.89	23.0	11	31	- 303
	1974	32.6	1.71	24.7	7	26	- 206
	1975	29.1	1.08	20.7	9	31	+ 295
	1976	28.7	1.03	18.5	6	12	+ 262
	1977	30.9	2.39	27.0	8	23	- 184

Table 4. Continued.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity Index
April	1972	41.3	1.91	21.9	4	5	- 652
	1973	38.9	2.84	34.7	14	14	- 520
	1974	45.8	1.87	3.2	0	0	- 764
	1975	32.9	1.77	16.1	8	24	- 141
	1976	43.4	3.35	21.9	4	4	- 663
	1977	48.1	.57	5.7	8	4	- 875
May	1972	50.7	1.73	trace	1	0	- 958
	1973	51.4	1.44	1.3	trace	0	- 989
	1974	48.3	3.00	12.1	3	3	- 880
	1975	46.9	4.88	21.5	9	6	- 803
	1976	55.5	1.95	trace	0	0	-1157
	1977	50.3	3.84	3.4	0	1	- 946
Nov.- May	1971-72	33.9	7.7	81.8	10	119	- 329
	1972-73	31.3	8.4	92.6	14	135	+1335
	1973-74	34.3	10.0	89.9	14	116	+2025
	1974-75	30.5	12.1	118.6	17	161	+2286
	1975-76	35.2	9.9	95.2	12	86	- 810
	1976-77	37.4	7.9	57.8	9	88	-2391
20 Year Ave.		32.4	9.5				

[1]+ Values indicate greater severity.

Table 5. Phenology of Lilac Development and Growth in Bozeman. Data provided by Donald K. Scharff, Professor, Biology Dept., Montana State University, Ret.

Year	Early Bud Stage[1]	Lush Full Bloom[2]	Remarks
$\bar{X}$ 1955-1970	12 May	8 June	
1971	11 May	10 June	
1972	3 May	31 May	
1973	16 May	11 June	
1974	3 May	13 June	
1975	18 May	24 June	Latest recorded for both
1976	-	2 June	
1977	25 April	28 May	Earliest Records for both

[1]Early bud stage = first sight of flower buds, leaf buds will be open and new growth will be about 1" long.
[2]Peak of bloom.

Table 6. Estimates of numbers of mule deer on the Armstrong Winter Range, Bridger Mountains, April, 1977.

Estimated Numbers Total	S^2 [1]	Remarks
222	71.6	$\bar{X}$ Lincoln Index for 7 best ground surveys (> 50 deer observed/survey) and only readable collars (55-57)
201	44.6	$\bar{X}$ Lincoln Index for 7 best ground surveys (> 50 deer observed/survey) and all collared deer (66-68)
202	-	Schnabel Index for 7 best ground surveys and readable collars (55-57)
186	-	Schnabel Index for 7 best ground surveys and all collared deer (66-68)
204	-	Schnabel Index for all (13) ground surveys during April and readable collars only (53-57)
186	-	Schnabel Index for all (13) ground surveys during April and all collared deer (64-68)

[1]Variance

not been seen on the Armstrong Range since the spring of 1975 or earlier. Also, observations indicated that 30-35 percent of all deer on the winter range were collared. The mean percentage of collared deer in all observations during April was 33.7 percent, with a range from 24.1 to 48.3 percent among individual observations. The mean for the seven best observation periods, when 50 or more deer were recorded, was 34.0 (26.0-48.3) percent. Between 25 percent and 40 percent of all deer on the Armstrong Range were marked at various times during the previous three winters (Hamlin 1977).

The mean Lincoln Index for the seven best observation periods in April, using only observations of recognizable collars, was 222 mule deer; though the variance among individual observations was high (Table 6). The mean, using observations of collared deer on a base of 66 to 68 collared animals in the population at the time observations were made, was 201 deer; and the variance among estimates for individual observation periods was much less. Schnabel indices (Overton and Davis 1969), based on readable collars, were similar at 202 deer and 204 deer for the best 7 days and for all observations during April, respectively (Table 6). These data, using all collared deer observations, indicated 186 deer present. In our judgment, the latter would be a minimal estimate which may be somewhat lower than actual numbers present; while an estimate of 222 would be maximal and probably too high. Intermediate figures, indicating approximately 200 animals, are believed to represent the best current estimate of mule deer numbers on the Armstrong Range, and are most consistent with other data. A point-estimate of 200 mule deer is also obtained assuming a total collared deer population of 68 animals to represent 34 percent of all deer using the area.

Trends in mule deer numbers and sex and age composition of late winter-spring populations from 1973 through 1977 are shown in Table 7. Lincoln Index and Schnabel estimates placed the 1973 spring population at approximately 230 deer (Mackie et al. 1976). Although inadequate observational data were obtained through winter-spring 1974 to calculate numbers during that period, an estimate of 220-230 deer is assumed as consistent with population data obtained from 1972-73 through 1974-75. Thus, fawn production and survival were similar to slightly lower in 1973-74 as compared with 1972-73, while over-winter mortality appeared to be about the same (Table 8). Also, approximately 210 mule deer occurred on the Armstrong Range in January 1975 (Mackie et al. 1976). This included only about 36 fawns, far fewer than must have occurred in early winter of the previous two years. It also included about 32 fewer adult females and 14 fewer males (5 adults and 9 yearlings) than would have occurred in a 1974 spring population of 220. The difference in adult males could represent harvest removals during the fall of 1974. With a similar hunting season in 1973, Hamlin (1974) reported a known kill of 28 deer (15 males, 8 females and 5 fawns) between Reese and North Cottonwood Creeks, the area of greatest summer-fall concentration of deer from the Armstrong Winter Range (Pac 1976). The difference in numbers of adult females, however, would seem to reflect some other factor, possibly the use of another winter range in 1974-75. Such a conclusion might be supported by the "unexplained increase" of about 25 females in the mule deer population from late spring 1975 to the winter-spring of 1975-76 (Table 7, Mackie and Stewart 1976). The difference could also be due to variation in sampling or other errors in estimates between years.

Table 7. Estimated late winter-spring mule deer populations on the Armstrong Winter Range, 1973-1977.

Year	Total Number	No. Ad. Females	No. Males		No. Fawns
			Adult	Yrlg.	
1973	230	123	31	27	49
1974[1]	220	130	27	23	40
1975	140	92	35	8	5
1976	170	118	37	3	12
1977	200	120	24	6	50

[1]No population estimate calculated. A spring population slightly lower than that of 1973 is assumed as consistent with fawn production and survival for 1973 and 1974 and an early winter estimate of 210 mule deer on the range in January 1975 (Mackie et al. 1976).

Table 8. Number and age classes of winter-killed mule deer found on the Armstrong Winter Range 1971-1976.

Year	Number				
	Total	Fawns	Yrlg.	Prime	Old
1971-72	19	9	-	-	10
1972-73	18	12	-	1	5
1973-74	12	10	-	-	2
1974-75	42	16	2	10	14
1975-76	2	2	-	-	-
1976-77	2	-	-	1	1
Total	95	49(51.6%)	2(2.1%)	12(12.6%)	32(33.7%)

Over-winter changes in fawn:adult ratios during 1972-73 (Schwarzkoph 1973) and 1973-74 (Table 9) indicated fawn mortality of about 25 percent and 29 percent, respectively, during these two periods. Some, though relatively minor, mortality of adults also occurred each year (Table 8). Thus, early winter populations would have included at least 250 mule deer in 1972-73 and 240-250 in 1973-74; and total over-winter mortality would have been 8-10 percent each year. The 210 deer occurring in early winter 1974-75 were 30-40 animals (12-16 percent) fewer than occurred at the same time in the previous two years. As noted above, the presence of fewer fawns (21:100 adults in January 1974-75 vs. 31:100 in 1973-74 and 36:100 in 1972-73) would account for a part, perhaps one-half, of the difference while the remainder reflected the occurrence of fewer adult females than expected.

Over-winter mortality increased sharply in 1974-75 to 30-35 percent of animals present in January. Included were 85-90 percent of the fawns and about 22 percent of the adults (Mackie et al. 1976). The 140 mule deer remaining in early June were 35-40 percent fewer than occurred in either 1973 or 1974.

Data for 1975-76 (Mackie and Stewart 1976) indicated 170-180 deer on the Armstrong Range from January through April, including only 12-15 fawns and very few yearlings of either sex. Over-winter mortality was slight (Table 8). Pac (1976) found only four deer killed by hunters during the fall of 1975 within the principal summer-fall range of deer from the Armstrong population. The estimated 170 deer present in the spring of 1976 were approximately 20 percent more than occurred in June 1975. This increase was not expected and cannot be explained by either numbers of fawns present or immigration of yearlings from other areas. Rather, it appeared to reflect the occurrence of 20-25 more adult females than were present in the spring of 1975. Mackie and Stewart (1976) concluded that the increase reflected occasional if not persistent use of the Armstrong area in 1975-76 by unmarked deer which in past years spent most of their time elsewhere, particularly south of Bill Smith Creek. Data presented in this report suggest that these animals may have spent only the 1974-75 winter off the Armstrong Range.

Population calculations and data for 1976-77 indicate that most of the adult females or other animals added to the Armstrong population in 1975-76 continued to use the area in 1976-77 and that an additional increase of approximately 30 deer (18 percent) also occurred. Most of this increase can be attributed to relatively high fawn survival to and through the 1976-77 winter (Tables 7 and 9); though hunting and over-winter mortality of adults, especially adult females, was also exceptionally low (only 100 either sex permits were issued for Hunting District 312 which includes the Bridger Range in 1976). Numbers of adult males appeared to decline, possibly reflecting greater hunting mortality, a relatively high turnover rate among males as compared with females, and a third successive year of low recruitment of yearling males (Tables 7 and 9). Although hunter harvest data were limited, available information suggests that no more and possibly even fewer deer were killed during 1976 than in 1975. Only two (2.8 percent) of 64-78 collared deer available to hunters in the fall of 1976 were reported killed (Table 10).

TABLE 9. AERIAL CLASSIFICATIONS OF MULE DEER ON THE ARMSTRONG WINTER RANGE, JANUARY 1972 THROUGH APRIL 1977[1].

			NUMBERS							RATIOS			PERCENTAGES		
			Total Count	Total Class.	Adults	Males	Females	Fawn	Uncl.	F:100 Females	F:100 A	Males:100 Females	% Fawn	% Ylg Males	% Spike Ylg Male
Reese Cr. - N. Cttnwd.	1971-72	Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
		Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
	1972-73	Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
	1973-74	Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
		Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
	1974-75	Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
		Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
		Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
	1975-76	Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
		Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-
	1976-77	Jan. 5-9	90	90	70	14	56	20	-	36	29	25	22	21	100
		Mar. 10-11	116	116	87	-	-	29	-	-	33	-	25	-	-

[1]Includes some animals ranging between Bill Smith and Reese Creeks not included in the Armstrong Winter Range population.

Table 10. Known hunting mortality of mule deer marked on the Armstrong Winter Range, 1972-1976.

Year Marked	Number Marked	Year Killed 1972	1973	1974	1975	1976	Total
1972	5	1(1½M)	1(2½M)	0	0	1(5½M)	3
1973	16	-	0	1(7½M)	0	0	1
1974	39	-	-	1(1½M)	0	0	1
1975	36	-	-	-	2(4½M)(6½F)	1(3½+M)	3
1976	10	-	-	-	-	0	0
Totals	106	1	1	2	2	2	8
No. Mkd. in Pop.[1]		5	20	56/58	67/69	64/78	
% Shot		20.0	5.0	3.5	3.0	2.8	

[1]1974-1976 = Known No. Marked/Total Possible Marked Present.

The approximately 200 mule deer associated with the Armstrong Winter Range in the spring of 1977 indicate that deer numbers on this area have substantially recovered from the low experienced in the spring of 1975. Thus, with continued high over-winter survival, they are within one year's reproduction of numbers present in 1972-73 and 1973-74. However, the increase was substantially abetted by some movement of animals onto the Armstrong Winter Range in the winter of 1976 or at least a return of some animals which spent the winter of 1974-75 elsewhere and thus, probably is not indicative of the change in mule deer numbers in the Bridger Mountains as a whole.

It may also be significant that the increase has been marked by high adult survival, particularly among females, which could reflect reduced hunting effort and harvest. Hunting, however, has not been a significant factor in the mortality of marked deer, at least since 1973. Of 106 deer tagged on the Armstrong Range through the spring of 1976, only 7.5 percent had been killed by hunters through the fall of 1976; and of the marked deer available from 1972 through 1976, an average of only about 3.5 percent were reported shot by hunters in any one year. Furthermore, only an additional 16 percent of all deer marked prior to the 1976-77 winter cannot be accounted for; and most of these were last observed during or prior to the severe 1974-75 winter-spring period of high deer mortality.

At the same time, 22.6 percent of all deer marked between 1972 and 1977 have died due to other mortality factors (19.8 percent natural and 2.8 percent as recapture trap casualties). Greater mortality has accrued to males than to females. Fifteen (35.7 percent) of 42 bucks tagged were dead by the spring of 1977, including 7 shot by hunters. Ten (23.8 percent) could not be accounted for. Among does, 16 (25 percent) of 64 tagged were dead by 1977, of which only one was reported shot by hunters. Another 18 (28.1 percent) could not be accounted for as individuals with recognizable collars.

High adult survival on the Armstrong Range during 1975-76 and 1976-77 may also reflect a recent population age structure dominated by prime-aged animals. Winter mortality among adults in 1975 and earlier years was proportionately greater among old-aged deer (Table 8) and may have temporarily at least purged the population of this vulnerable age group. Among 54 deer trapped and "aged" (by tooth replacement and wear) during 1975-76 and 1976-77, were 1 fawn, 2 yearlings, 46 mature or prime-aged, and only 5 older (7½-years or older) animals. Four of the latter were males, all 7-8 years old, and one was an 8-10 year-old doe. It might be noted, however, that this age structure which now favors population growth may equally set the stage for another severe population decline should severe winter conditions prevail once again in the next several years. Thus, with few yearlings recruited the past three years, the population can be expected to be dominated by very young and increasingly older adult animals, the two groups most vulnerable to winter mortality. Indeed, even "normal" conditions during the next two or three years may be expected to result in mortality patterns similar to those of 1971-72 through 1973-74 (Table 8).

Fawn Production and Survival

Aerial classification of deer on the Armstrong Winter Range during helicopter surveys in early January and March 1977 are listed in Table 9 together with comparable classifications from previous years. The greater proportion of fawns in classifications in March as compared with January 1977 may have resulted either from sampling error or from somewhat greater concentration of deer on the winter range in March; though deer remained relatively dispersed throughout the winter. One small group of does and fawns was recorded, essentially on summer range, near the head of Johnson Canyon during both aerial surveys. A radio-collared doe observed with this group in January moved onto the winter range during the first week of February.

The 36 fawns:100 females and 29 fawns:100 adults recorded in January were the highest ratios recorded on the Armstrong Range since December 1973. The ratio of 33 fawns per 100 adults observed in March was the highest observed ratio recorded for late winter since the study began in 1971-72. These data, plus the lack of any observed mortality among fawns through the winter and during the May mortality survey of the range, indicated that very little, if any, fawn mortality occurred during 1976-77. In previous years since 1971-72, fawn mortality has ranged from about 12-15 percent (1975-76) to 85-90 percent (1974-75) with a 5-year average of about 40 percent from early to late winter.

Only 3 (21 percent) of 15 males observed in early January 1977 were yearlings. All were spike-antlered.

Habitat Use and Relationships

Winter Distribution, Movements, and Use of Habitat Types

This segment of the study during 1976-77 was conducted by a graduate student assistant as a supplementary project supported in part by the Montana State University Agricultural Experiment Station. The study will continue through the 1977-78 winter with the results reported in thesis form in June 1978 and included in the 1977-78 Deer Studies Report.

Spring Dispersal Movements

Weekly relocations of 12 radio-collared deer, eight adult females and four adult males (Appendix, Table 12), provided data on rate and patterns of movements off the winter range in 1977 as compared with 1976 (Mackie and Stewart 1976) and 1975 (Pac 1976). Two of these, both adult females, were first equipped with radio collars in late winter and spring 1975, five were collared in February and March 1976, and five were radioed in the winter-spring of 1977.

Of the two females monitored since 1975, one (Radio No. 11, Fig. 3) left the winter range on about the first of May 1977 and moved directly to the summer range area used in both 1975 and 1976 near the head of Johnson Canyon. This doe was among the first radio-marked deer to leave the winter range in all three years in which dispersal has been monitored. Departure dates were early June (1975), mid-May (1976) and the first of May in 1977; while arrival on the summer range was June 13 in 1975, May 13 in 1976, and about May 1 in 1977. Timing for all three years was associated with approximate dates when snow left the summer range area. The second doe (No. 4) moved onto a holding area along the north side of North Cottonwood Creek in early February, following the same movement pattern recorded in late May 1975 and 1976. After remaining there for more than a month, she abruptly returned to the winter range in mid-March. She continued to use the upper portion of the winter range and the adjacent area until mid-August 1977 when she moved onto the area used during the previous two summers.

All of the five deer (3 females and two males) first tracked in 1976 followed the same patterns of movement in 1977, though the timing of movements varied between animals and the two years. Three crossed the Bridger Divide to summer along the east slope of the Bridger Range. One adult female (No. 18), which spent both summers in the vicinity of Frazier Lake, was recorded first on this area on June 9, 1977 and on June 8, 1976. Another, a 3-year-old doe (No. 16), summering on a small area along the South Fork of Flathead Creek both years, moved onto summer range on May 12, 1977, about two weeks earlier than in 1976. The third (No. 15), an adult male which spent both years on a steep slope area just east of the Divide and above Ainger Lake, moved onto this area about the 20th of June in 1977,

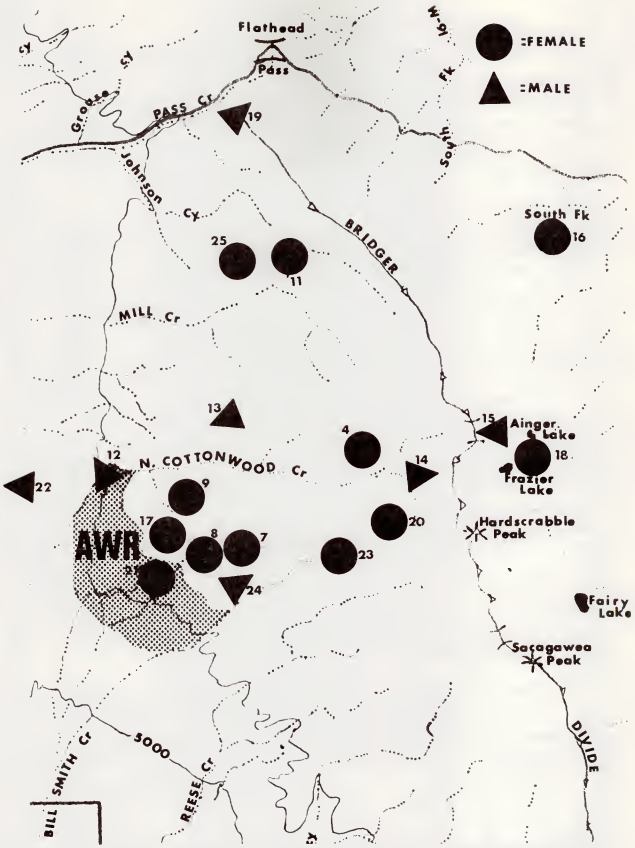

Figure 3. Generalized centers of summer activity of 19 mule deer (12 adult females and 7 adult males) radio-collared on the Armstrong Winter Range during 1975, 1976, and 1977. Numbers indicate individual animals listed in Appendix Table 12. See text for further explanation of movement patterns.

about two weeks later than 1976. Of the two animals which remained in the vicinity of the winter range, one, an adult female (No. 17), in both years ranged on and adjacent to the upper margins of the winter range. The other, a large adult male (No. 12), ranged along lower slopes north and south of the mouth of North Cottonwood Creek until late July 1977 and mid-August 1976 when he joined other bucks using grain fields below and about one mile west of the winter range for approximately a month each year. He then returned to the area used earlier where he remained in 1976 until the onset of rut in early November when he moved upward toward the Bridger Divide between North Cottonwood and Mill Creeks.

Among the three adult does first monitored in 1977, one (No. 25) left the winter range during the first week of June, moving directly northeast to a summer range along the main ridge between Johnson and Mill Creek Canyons. Another (No. 23) first moved to the head of Bill Smith Creek during the second week of June, but made at least two trips back and forth along the length of Smith Creek Canyon until late July. Thereafter she remained on the upper area. The third doe (No. 21), beginning in early May, moved extensively throughout the summer. Movements extended from lower slopes and fields below the winter range nearly to the North Cottonwood Creek Basin and from the ridge between Bill Smith and Reese Creeks north to the main ridge between North Cottonwood and Mill Creek Canyons. The two adult males also showed sharply different movements. One (No. 24) left the winter range about June 1 and summered along the south-facing slope of Bill Smith Creek Canyon immediately above the winter range. The other (No. 22) first left the winter range about the 20th of June, moving directly to the Krumholz along the Bridger Divide at the head of North Cottonwood Creek. On July 1 it was located just below the Divide at the head of Tom Reese Creek. On July 7, he returned to the winter range along the ridge between Smith and Reese Creeks, then moved northwest to grain fields below and 1-2 miles WNW of the winter range.

Dispersionary patterns of all mule deer (12 females and 9 males) radio-collared on the Armstrong Winter Range during 1975, 1976 and 1977, and monitored over one to three spring-summer periods, are shown in Figure 3. These summer "centers of activity" are very highly generalized, and serve only to illustrate about where the animals went and spent a substantial amount of time, if and/or when they left the winter range.

Previous studies (Hamlin 1974, Pac 1976) have indicated that mule deer collared on the Armstrong Range occur in greatest numbers during summer in an area extending from the winter range east to the Bridger Divide between Reese Creek and North Cottonwood Creek. However, 25-30 percent may normally range outside of this area (Pac 1976); and some marked animals have subsequently been relocated in almost all parts of the Bridger Range. Bucks have been particularly mobile and wide ranging, and may vary in their use of different ranges between years to a greater extent than does. Several males, marked as fawns, yearlings, or older adults have subsequently been relocated during winter on other areas along the west slope of the Bridger Range from Grouse Canyon on the north to the mouth of Bridger Canyon on the south. As yet, no marked female has been relocated on any other winter range.

Movement patterns of the radio-collared deer indicate that movements within and between seasons and years are behavioral characteristics of individual animals rather than attributes of the population as a whole. In general, while each animal has tended to follow a very similar pattern in movements and the areas and habitat types used each year and season, each has been somewhat different from the other. Because of this, terms or concepts such as migration and home range in particular may have only limited value as parameters or descriptors of habitat usage of the Armstrong deer population.

Although many deer associated with the Armstrong Winter Range clearly migrate, often over long distances, there is much variation in the timing and nature of "migratory" movements among the individual animals involved. Some deer never leave the vicinity of the winter range, others move only a short distance. Of those animals which leave the winter range and spend the spring, summer and/or fall elsewhere, each appears to go its own way to its own place at its own time (but probably at the same time relative to other deer) each year. Some individuals habitually leave the winter range in spring as soon as snow conditions permit, others not until later, including mid-summer or even the fall. Some move directly and rapidly, others drift more slowly, while still others may move back and forth between summer and winter or intermediate range areas several times before more or less settling down on either the summer or the winter range. Thus, there is no distinct or sudden migration of all or of even a substantial proportion of the population in either spring or fall.

Concepts such as winter, intermediate and summer range can be applied to mule deer of the Armstrong population only in the sense that they describe the seasonal limits, or at least concentration areas, of the population as a whole. They are only relative terms when applied to individuals. Yet, it is the movements and the areas and habitats selected and traditionally used by individual deer which prescribe seasonal ranges and distributional limits of the population; and changes in movements of individuals over time may lead to changes in seasonal ranges of the population. Furthermore, deer from the Armstrong winter population may during other seasons distribute themselves over most of the Bridger Range; and deer from any part of the Bridger Range may winter on any of the many wintering areas which exist. Because of this large samples of marked and radio-collared individuals are necessary to determine seasonal range limits for any particular population or population segment.

Movements or "home ranges" within seasons appear equally variable. Some individual deer appear to occupy relatively small and well defined seasonal ranges; others habitually use larger and less distinct range units, or their activity centers may shift periodically throughout spring, summer and fall. Still others may not occupy any definable habitat or home range, but wander more or less at random over a fairly large area.

Because all data concerning the distribution, movements and habitat usage of radio-collared and other marked deer have not been compiled and analyzed at this time, it is not possible to speculate on the reasons for the observed patterns of dispersal and movement, nor on their ecological or management significance.

Browse Utilization and Trend

Utilization data for antelope bitterbrush *(Purshia tridentata)* and big sagebrush *(Artemisia tridentata)* along transects located on major habitat types within the primary winter range during 1976-77 are presented in Table 11, together with comparable data obtained since 1972-73. These data indicate that 1977 utilization of both of these important winter browse species was low relative to use during the 1972-73 to 1974-75 winters, and similar to slightly higher than that of 1975-76. The increased use of bitterbrush in 1976-77, at least among transect No.'s 2, 3 and 4, probably resulted in part from cattle usage of that part of the winter range during 1976-77. Only very light cattle usage occurred on the winter range in 1975-76 (Mackie and Stewart 1976). Cattle have been observed to consistently utilize bitterbrush whenever grazing has occurred during early-mid winter; Bucsis (1974) reported that cattle accounted for 37 percent of total use of bitterbrush on footslope sites and 8-10 percent on steeper slopes.

The generally light to moderate overall usage of bitterbrush and very light utilization of sagebrush (even though deer numbers had increased) was probably due to several factors. Because of the mild open winter, deer ranged widely on and off the winter range (as defined by observations in past years) and all mule deer forage plants were available to the animals. Mackie et al. (1976) concluded that the welfare and survival of mule deer on the Armstrong Range is directly related to the ability of the population to exploit all available forage sources and supplies within the total winter range area. Also, browse production was at or near maximum during 1976 (Fig. 4), at least as compared with previous years of study.

Data presented in Figure 4 indicate that measured parameters of utilization of bitterbrush and big sagebrush may be greatly influenced by the amount of current annual growth which occurs. Current annual growth twigs of both species were nearly twice as long in 1976-77 as in 1973-74, the year of apparently poorest growth during the five years of study. Except for 1974-75, when deep and persistent snow cover concentrated extremely high browsing pressure, the relationship between twig length growth and total twig length utilized has essentially been negative. Thus, the deer may not respond to greater available amounts of these forages with greater usage, nor will utilization patterns necessarily follow population levels and trends. The amount of length growth available may also influence proportionately different levels or even different trends in utilization parameters such as percentage of leaders used, percentage of twig length utilized and percent utilization by weight (Table 11). Such variation has also been suggested by recent evaluations of browse survey methods and criteria (Mackie 1976, Jorgensen and Mackie 1976, and Jorgensen 1977).

Table 11. Utilization of antelope bitterbrush and big sagebrush on the Armstrong Winter Range, 1972-73 through 1976-77. Data for 1972-73 and 1973-74 from Bucsis (1974).

ANTELOPE BITTERBRUSH

		Transect Number							
	Year	T-2	T-3	T-4	T-5	T-8	T-15	T-18	Ave.
	1972-73	-	83	80	85	84	78	88	84
	1973-74	90	89	-	90	89	74	90	86
Percent	1974-75	85	89	83	90	86	85	85	87
CAGT used	1975-76	78	64	37	79	61	44	52	59
	1976-77	56	52	35	43	57	14	41	43
	1972-73	-	44	50	60	62	57	61	57
	1973-74	61	68	-	57	56	53	57	58
Percent	1974-75	74	87	58	83	88	68	67	66
Lgth Utiliz.[1]	1975-76	16	17	17	22	31	28	21	19
	1976-77	35	35	22	22	34	8	18	25
Percent	1974-75	76	85	57	79	64	54	55	59
Wt. Utiliz.	1975-76	7	8	7	17	25	26	18	13
	1976-77	35	29	17	18	30	7	11	21

[1]Mean Unbrowsed Twig lengths were: 1972-73=103mm; 1973-74=93 mm; 1974-75= 112 mm; 1975-76=139 mm; and 1976-77=160 mm.

BIG SAGEBRUSH

		Transect Number					
	Year	T-2	T-3	T-4	T-5	T-8	Ave.
	1972-73	-	68	85	87	89	81
	1973-74	77	72	-	89	90	84
Percent	1974-75	71	76	82	86	87	83
CAGT used	1975-76	15	15	6	49	57	28
	1976-77	4	12	36	23	38	23
	1972-73	-	28	33	38	51	39
	1973-74	42	34	-	46	51	44
Percent Lgth.	1974-75	52	58	68	60	73	62
Utiliz.[2]	1975-76	2	2	2	-	8	3
	1976-77	3	8	24	14	23	14
Percent	1974-75	61	65	76	72	81	71
Wt. Utiliz.	1975-76	3	3	3	-	11	4
	1976-77	T	1	1	5	1	2

[2]Mean Unbrowsed Twig lenths were: 1972-73=66 mm; 1973-74=58 mm; 1974-75= 70 mm; 1975-76=99 mm; and 1976-77=104 mm.

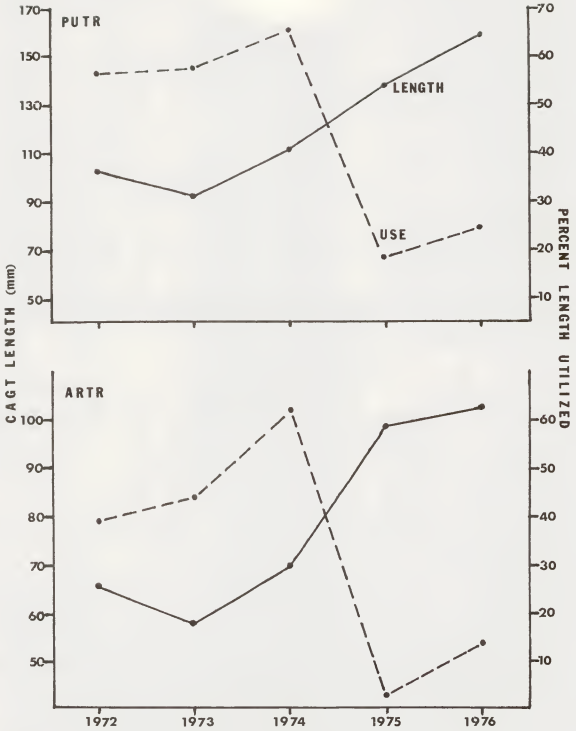

Figure 4. Relationship between mean current annual growth twig (CAGT) length and mean percentage of total twig length utilized annually among antelope bitterbrush (PUTR) and big sagebrush (ARTR) transects on the Armstrong Winter Range, 1972-73 through 1976-77.

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Submitted by: R. J. Mackie

C. J. Knowles

Appendix Table 12. List and current status of radio-collared deer on the Armstrong Range.

Radio No.	Animal Number	Sex	Age[1]	Date Collared	Collar Type	Collar Color Code	Trans.[2] Freq.	Remarks/Status
1.	14-73(1)	F	3½+	2-10-73	Belt	White/Black-Red	M-4	Failed immediately.
2.	7-74(2)	F	Mat.	4-16-74	Tygon	Solid Blue	M-4	Failed?, Never relocated.
3.	8-74(3)	F	Mat.	4-16-74	Tygon	Solid Yellow	M-8	Failed May 1974.
4.	3-72(4)	F	6½+	3- 6-75	Tygon	Yellow-Red CS	AVM-3/4	OK through summer 1974.
5.	34-74(5)	F	Mat.	3-29-75	Tygon	Red-White	AVM-6	Winterkill May 31, 1975.
6.	41-74(6)	F	Mat.	3-29-75	Tygon	Yellow-Green	AVM-1	Winterkill May 2, 1975.
7.	16-75(7)	F	2½+	4- 9-75	Tygon	Solid Red	AVM-8	Failed late July/August 1976.
8.	17-75(8)	F	3½+	4-10-75	Tygon	Red-Blue	AVM-2	Failed mid-August 1976.
9.	20-75(9)	F	5½+	4-13-75	Tygon	Blue-Yellow	AVM-11	Shot by hunter 10/29/75.
10.	27-75(10)	F	3½+	4-24-75	Tygon	Black-White CS	AVM-12	Winterkill May 13, 1975.
11.	9-73(11)	F	7½+	5- 8-75	Tygon	Red-White	AVM-6	OK through summer 1977.
12.	1-76(12)	M	5½+	2-22-76	Tygon	Green-White	AVM-6	OK through summer 1977.
13.	2-76(13)	M	6½+	2-22-76	Tygon	Solid Green	AVM-1	Failed late June 1976.
14.	2-72(14)	M	4½	2-25-76	Tygon	Black-Yellow CS	AVM-4	Shot by hunter 10/30/76.
15.	6-75(15)	M	5½+	2-27-76	2" PVC	White/Red Bar	AVM 2-8	OK Summer 1977-Replaced older trans. 3/27/77.
16.	1-75(16)	F	1½	3- 3-76	Tygon	Solid Yellow	AVM-11	OK through summer 1977.
17.	1-73(17)	F	4½+	3-16-76	Tygon	Green-Yellow	AVM-5	OK through summer 1977.
18.	11-73(18)	F	6½+	3-16-76	Tygon	Solid White	AVM-10	OK through summer 1977.
19.	6-76	M	Mat.	3-25-76	Tygon	Black-White	AVM-7	Failed November 1976.
20.	7-76	F	Mat.	3-27-76	Tygon	Blue-Yellow	AVM-9	Failed January 1977.
21.	1-77	F	Mat.	1-31-77	1½ PVC	Black-Yellow	AVM-3	OK through summer 1977.

Appendix Table 12. Continued.

Radio No.	Animal Number	Sex	Age	Date Collared	Collar Type	Collar Color Code	Trans. Freq.	Remarks/Status
22.	8-75	M	Mat.	3- 3-77	Tygon	White-Red	AVM-8	OK through summer 1977.
23.	19-74	F	Mat.	3- 5-77	2" PVG	Blue/White Stripe	AVM-1	OK through summer 1977.
24.	12-73	M	6½	3-20-77	Tygon	Red-Yellow	AVM-7	OK through summer 1977.
25.	4-77	F	8½+	3-22-77	1½ PVC	White/Red Stripe	AVM 2-5	OK through summer 1977.
26.	35-75	M	6½+	4- 2-77	Tygon	Black-Yellow	AVM-5	Died April/May 1977

[1]Estimated or known age when radio collar attached, several were radio-equipped as recaptures of earlier collared deer; e.g., No's. 14-73, 3-72, etc.

[2]M = Markusen Electronics; AVM = AVM Electronics. AVM Channels 1-12 as designated for single band receiver.

Job Title: Habitat selection of radio-marked mule deer on the Armstrong Winter Range, Bridger Mountains, Montana.

Job Objectives: To determine the extent to which individual deer vary in their use of winter habitats; and to evaluate the reliability of observational data in indicating relative use and importance of various habitat types by mule deer during winter.

Introduction

The study is being conducted on the Armstrong Winter Range located on the west slope of the Bridger Mountains, approximately 20 miles north of Bozeman. The area has been thoroughly described by Wilkins (1957) and Bucsis (1974). Subsequent studies of the winter range and its associated mule deer population have been carried out by Schwartzkoph (1973), Hamlin (1974), Mackie et al. (1976), Pac (1976) and Morton (1976). This report summarizes and evaluates the methods employed and the results obtained during the first season's field work, which began December 15, 1976 and ended April 1, 1977.

Methods

The main emphasis of this study was on tracking radio-collared deer and a total of 14 animals were tracked during the course of the study period. One radio ceased to function during the first week of January and another was on an animal that died during the early part of April. Seven of the radios were fitted to deer captured on the winter range during January, February and March, 1977. The remainder were on deer captured during the winters of 1974-75 (two) and 1975-76 (five). Twelve radios (8 does and 4 bucks) were operational as of April, 1977.

Radio-collared deer were monitored on foot and from the air with the use of a Piper Supercub aircraft piloted by James Stradley of the Gallatin Flying Service. Twelve flights were made during the study period; 2 in December, 1 in January, 4 in February and 5 in March.

Comparative observations of habitat usage of neckbanded and unmarked deer were obtained on foot or from a vehicle with the aid of binoculars and a 20X spotting scope. Observations of non-radioed animals were also recorded during aerial observations. For all deer sightings the following data were recorded whenever possible: number of individuals, sex and age classes, markings, habitat type, elevation, cover exposure, time and activity. For some sightings, windspeed was measured with a Dwyer Windmeter. When my presence was undetected it was also possible to observe and record deer activity and behavior.

The habitat type designations followed Pac (1976) for non-winter range areas and Bucsis (1974) for the winter range. When animal locations were on the border between 2 or more habitat types I treated them as a combination of those habitat types and a discrete unit.

Ground observations were irregularly made throughout the study period. Aerial flights during February and March were at approximately weekly intervals, weather permitting.

Temperature and relative humidity were monitored on the area by use of a hygrothermograph weather station located in an exclosure on an exposed west slope at an elevation of 5,850 feet, representative of overall winter range. A maximum-minimum thermometer was located on a timbered north slope to record maximum and minimum temperatures in a typical sheltered area. Temperature readings were taken weekly at this site.

Some experimentation was done with time lapse cameras in the hopes of recording deer activity. Also, beginning in February, black and white photographs were taken of the winter range at a 1/4 mile distance with an instamatic camera at 5 to 7-day intervals in an attempt to keep a record of snow cover.

During March and April notes were taken on plant phenology and some samples were collected and pressed for future reference and comparison with next year's spring growth.

Results and Discussion

The winter of 1976-77 was very open and mild. These conditions severely limited observations on the winter range. Some deer that normally winter on the Armstrong Winter Range spent at least a portion of the winter on summer or intermediate range areas. Unusually wide deer dispersion and high elevation sightings were noted on both the January and the March helicopter surveys of the area (R. J. Mackie, pers. comm.). Many neckbanded animals that normally winter on the Armstrong Winter Range were not accounted for until the latter part of March or until spring green-up in April.

Radio relocations on the study area were hampered by the rugged terrain and the presence of large rock outcroppings and rock slides. These caused signal bounce and made accurate ground relocations on the upper portions of the winter range very difficult except at very close range. Good radio relocations from the periphery of the winter range generally are possible only when the animal is on lower slopes. Because of this, plus the inaccessibility of deer, aerial relocations were essential in recording movements and habitat usage during February and the first half of March.

Flights made December 15 and 24 revealed that the radio-collared animals were moving onto the winter range, although one female (channel 6) was still on her summer range December 29. By the end of the first week of January all radioed animals had been located within the boundaries of the winter range. During February and the first half of March deer were concentrated on the upper boundary of the winter range (7,800-8,000 feet elevation). The weather was very mild during this period. Green grass was in evidence on lower slopes by March 18 and a *Ranunculus* spp. in bloom was sighted on that date. Spring green-up progressed noticeably from that date on, without interruption. During late March andApril the deer numbers on the winter range increased dramatically, with activity concentrated on

lower slopes. Deer congregated in the north-facing timbered "fingers" during the day and grazed extensively on the open lower slopes during early morning and evening. In contrast to recent more normal and severe winters these lower slopes were used intensively only during the spring green-up period. During most of the winter of 1977, feeding activity was more concentrated in timbered types and on open "benches" above 6,200 feet. They also seemed to be closely tied to snow cover, moving up and down in elevation with the snow line, and apparently preferred to stay in areas having 4-6 inches of snow on the ground. Quite deep snow did not seem to hinder movement. It also appeared that at least some animals preferred to feed in areas with snow cover, digging through 6 inches of snow or more to feed, rather than moving 20 yards to feed on exposed ground. This preference may be related to moisture content of forage or some other factor. Several times during the winter it was observed that deer had been digging through as much as 1½ feet of snow on the downhill side of fallen logs in timbered areas to feed on elk sedge *(Carex geyeri)*, which remained green. These logs seemed to be systematically sought out for this activity.

Timbered areas were used extensively for day bedding, especially on windy days. Beds located in these areas were usually at the base of a large tree, and always on the uphill side of the trunk. Ridge crests were also prominent bedding areas. Many of these exposed beds appeared to have been used during the night. Open ridges and south slopes were popular bedding areas on warm sunny days. Deer seemed to seek out the bases of rocks for sunning on warm days.

Distinct social groupings were evident during the winter. Deer were most social during warm days when they bedded on exposed hillsides in very large groups. During January it was possible to predict the general area of the winter range where a particular group could be found, and which marked animals would likely be present.

Habitat utilization data from the first season's field work has not been statistically treated. Examination of relocations plotted on aerial photos and the number and kinds of habitat types used by each radio-collared deer during the study period indicate that their preferences may very well be individualistic. However, for most of the winter, there were only 4 to 6 relocations per animal per month.

Aerial relocations of radioed deer provided some information concerning deer movements and use of areas other than the normal winter range. Two does (channels 4 and 5) both spent time on the north ridge of North Cottonwood Creek during February and March. Another (channel 4) spent all of February and the first half of March on this area, which is part of her usual summer range. Still another doe (channel 10) made two trips to the same area in a period of two weeks; one during the end of February and one during the first part of March. This animal also spent three weeks in this vicinity before going to her summer range on the east side of the Bridgers in May. It is questionable whether these movements would have taken place during a normal winter.

Because most of the deer spent most of their time in the timber, both ground and aerial observations of non-radioed deer were biased toward open areas. I do feel the relocation of radio-collared animals thus

provided an indication of the general movements and activities of the winter range population that could not have been obtained from general ground or aerial observation.

The two time lapse cameras were of little or no value in measuring deer activity during the open winter since deer spent very little time on open slopes where use of the cameras is most practical. Activity in these areas occurred mostly during the hours when light was inadequate for good pictures. Also, one frame every 60 seconds was too slow to capture animal activity.

Black and white snapshots of the winter range, taken from a distance of approximately 1/4 mile during February and March provided a record of snow cover on the area. However, snow cover changed rapidly due to frequent snow flurries and rapid melting on south slopes; and at least one and preferably two pictures per day would be necessary to build a good record of snow cover patterns and changes on the area. A time lapse camera may be more useful for this purpose, and could also be used to record cloud cover in conjunction with snow cover.

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Prepared by: Heidi B. Youmans

Job Title: Habitat relationships of mule deer associated with the Schafer Creek Winter Range, Bridger Mountains, Montana.

Job Objectives: To determine and describe seasonal habitats and habitat use of mule deer associated with the Schafer Creek Winter Range; and to compare habitats, habitat usage, and habitat relationships of mule deer on the Schafer Creek Range with those of mule deer on the Armstrong Range.

Introduction

Population studies of mule deer in the Bridger Mountain Range (Mackie et al. 1976) have indicated that numbers, fawn production, and overwinter mortality of mule deer vary within and between years among winter ranges. During the past five years, somewhat higher fawn production and survival have been noted for the southern portion of the Bridger Range as compared with the northern portion, which includes the Armstrong Winter Range on which intensive mule deer studies have been conducted. Because of this and some apparent general differences in winter range characteristics between areas, this study was established to obtain data on mule deer habitats, habitat usage, and habitat relationships in the southern portion for comparison with existing data for the Armstrong Range in the north. Field studies were initiated on July 1, 1976 as a graduate thesis (M.S.) research study. This report briefly summarizes efforts during the first field season.

Description of the Study Area

The Schafer Creek Winter Range is located along the west slope of the Bridger Mountain Range, approximately 8 miles north of Bozeman and 7.5 miles due east of Belgrade, Montana. The area consists of a strip about one mile in width and 3.5 miles in length running generally north to south around a convexity or "toe" that projects westerly into the Gallatin Valley from the main Bridger Range. Thus, the area is topographically similar to the Armstrong Winter Range, located approximately 10 miles further north along the west slope.

There are three major drainages--Middle Cottonwood Creek, Schafer Creek, and Bostwick Creek--within the area. In addition, there are about 11 minor or subdrainages. Middle Cottonwood Creek forms the southern boundary, and Miser Canyon the northern boundary. The east-west direction of all drainages creates a series of north and south facing slopes throughout the area. The south-facing slopes tend to be open, grass or sagebrush-grass dominated habitat types; while the north-facing slopes tend to be forested, Douglas fir types. At higher elevations there are some southwest to northwest facing slopes which may be either sagebrush-grass or forested.

Elevations range from about 5,000 feet where footslopes meet the valley floor to 7,186 feet on a peak between Schafer Creek and Bostwick Creek. The upper elevation limit of most of the winter range is about 6,800 feet.

Procedures

Full-time field work was conducted from June 14, 1976 to September 16, 1976. The first month was devoted to reconnaissance and familiarization with the study area and its vegetational cover. In addition, all known landowners were contacted to gain access and permission to work on their lands. Throughout the summer, plants occurring on the area were collected and identified; over 160 species were collected. Habitat types occurring were tentatively recognized and classified according to descriptions of Pfister et al. (1974) for forested types and Mueggler and Handl (1974) for shrub and grassland types. As a portion of the area was typed, types were outlined on an aerial photograph, and notes were made of pertinent descriptive characteristics. Additions, corrections, and modifications were made throughout the summer.

Eleven habitat types were tentatively recognized:

Pseudotsuga menziesii/Symphoricarpos albus	(DF/SYAL)
Pseudotsuga menziesii/Juniperus scopulorum	(DF/JUSC)
Pseudotsuga menziesii/Agropyron spicatum	(DF/AGSP)
Pseudotsuga menziesii/Vaccinium globulare	(DF/VAGL)
Pseudotsuga menziesii/Acer glabrum	(DF/ACGL)
Artemisia tridentata/Agropyron spicatum	(ARTR/AGSP)
Artemisia tridentata/Festuca idahoensis	(ARTR/FEID)
Festuca idahoensis/Agropyron spicatum	(FEID/AGSP)
Festuca idahoensis/Agropyron smithii	(FEID/AGSM)
Philadelphus lewisii/Symphoricarpos albus	(PHLE/SYAL)
Populus tremuloides-Crataegus douglasii/Symphoricarpos albus	(POTR-CRDO/SYAL)

After the entire winter range was typed, quantitative data were obtained by sampling in representative stands of the more important plant communities. The point-center quarter method (Cottam and Curtis 1956) was used to determine tree and shrub densities on forested and shrub types; while canopy-coverage of grasses, forbs and low shrubs was measured on all types using a 2 x 5 dm plot (Daubenmire 1959) for grasses and forbs and a 4 x 10 dm plot for shrubs. Thirty-three permanent transects were established. Each transect consisted of 10 sampling points, spaced 15 meters apart along a straight contour line at a set elevation through what appeared to be typical for that habitat type. In some cases, two parallel lines of 5 and 5 or 6 and 4 points were established, with the second line 10 meters down slope from the other. All transect locations were noted on aerial photos for future relocation.

The occurrence of mule deer and other big game animals on the winter range was recorded incidental to other activities during summer. Seven mule deer, four elk, and three black bear observations were recorded.

Plans for Future Studies

Distribution, movements, and habitat usage of mule deer from the Schafer Creek Winter Range will be monitored in full-time field studies on summer

range from mid-June through mid-September 1977, and on the winter range from mid-December 1977 through mid-March 1978. The final thesis report will be written during the spring of 1978.

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Prepared by: William Steerey

Job Title Mule deer population ecology and habitat relationships in the Missouri River Breaks, Montana.

ABSTRACT

Information on mule deer populations in the Missouri River Breaks has been collected since 1960. This report presents current information collected in the Missouri River Breaks as part of the statewide deer study. Causes of low fawn recruitment leading to a declining mule deer population are being investigated as a major emphasis of the study. Initial mule deer productivity (150 fawns/100 producing females) appears to be near species potential and substantially higher than observed recruitment in recent years (11-30 fawns/100 adults). The major problem appears to be low fawn survival rather than low fawn production. During 1976-77, fawn mortality was highest from birth to early October and lowest during winter. During 1975-76, fawn mortality was substantial during winter as well as during summer. Coyote predation or probable coyote predation has been the major documented cause of fawn mortality to date. Sample sizes have been small to date and occurrence of mortality at or shortly after birth and causes of mortality from September through spring have not been well documented. Some fawns as well as adults were lost to probable coyote predation during winter 1976-77 as previously documented by Knowles (1976) during the winter 1975-76. Hunting mortality at present is of negligible population consequence since the bag limit has been one deer, bucks only for the last two years. Hunting mortality of males was extremely low in 1976. Fawn recruitment was higher and total known mortality, including predation, declined substantially in 1976-77 over 1975-76. Given continued low adult mortality and fawn recruitment as high or higher than the 1976-77 level, the mule deer population should increase. Minimum home ranges ranged from 900 to 1,680 acres and averaged 1,222 acres for adult female mule deer. These home range sizes are considerably larger than the 300-400 acre home ranges reported by Mackie (1970) for this same area. Food habits data collected during winter 1976-77 indicate a much greater use of Rubber rabbitbrush *(Chrysothamnus nauseosus)* and much less use of big sagebrush *(Artemisia tridentata)* than Mackie (1970) found in rumen samples during the 1960-64 period of high mule deer populations. Use of browse was higher and use of forbs and grasses lower during winter 1976-77 than during winter in the 1960-64 period.

Job Title — Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana.

Job Objective — To further determine the environmental requirements of mule deer and factors regulating mule deer populations in the "breaks" type of eastern Montana.

To further determine the direct and indirect effects of livestock grazing management under rest-rotational and continuous grazing systems upon deer populations and habitat relationships and upon deer-elk interrelationship in the "breaks" type.

To develop new and improved guidelines for management of mule deer populations and their habitats in the "breaks" type of eastern Montana and for consideration of deer habitat requirements in elk, livestock, and range management programs in this type.

INTRODUCTION:

In 1960, an intensive study of mule deer and their relationship to elk *(Cervus canadensis)* and domestic livestock was established on a representative 75,000 acre area in the Missouri River Breaks approximately 25 miles northeast of Roy, Montana. Habitat use and population studies were conducted from June 1960 through September 1963 and intermittently from October 1963 through May 1964 (Mackie 1970). From the summer of 1964 through spring 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer (Mackie 1976). Mackie (1970) presented historical information on mule deer in the "Breaks", discussed development of the existing population from the late 1930's through the early 1950's, and described trends in numbers, sex and age composition and harvest from 1960 through winter-spring 1964. Subsequent reports (Mackie 1966, 1973 and 1976) extended these data through early winter 1975-76. In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks type habitat of eastern Montana.

A mule deer population decline on the study area, which started in winter 1971-72, has continued to the present time (Mackie 1976). Population declines have occurred on this area in the past, but recovery has generally started within a year or two of the decline. Low fawn production and/or survival and ultimately low fawn recruitment was apparently the problem involved in the continuing population decline of the mule deer herd in recent years (Mackie 1976). Low fawn ratios in some prior years were associated with severe environmental conditions such as drought in 1961-62 and severe winters in 1964-65 and 1971-72. However, severe environmental conditions apparently cannot be implicated in the relatively

low fawn production and/or survival during the years 1973 through 1976. From 1972 to 1976 normal precipitation during the growing season and mild, open winters have been the general rule (Mackie 1976).

A preliminary report by Knowles (1976) indicated that coyote predation may have been an important cause of mortality of mule deer, at least during winter 1975-76. A graduate student project investigating mortality of mule deer fawns from birth to September was initiated in June 1976. Dood (interim report 1976) indicated that coyote predation was implicated in at least some summer mortality of mule deer fawns on the south side Missouri Breaks study area.

Present work on the project emphasizes determination of fawn production and survival, population dynamics of the herd and causes and timing of mule deer mortality.

METHODS

Population data were obtained during fixed-wing (Piper Supercub) surveys in October and helicopter surveys during December and March. Sex and age classifications and deer distribution and habitat use were obtained during all aerial surveys and population estimates were made using data obtained during helicopter surveys. Information on deer and cattle distribution and habitat use were also obtained during aerial flights in July and September. Supplementary information was obtained throughout the year from the ground during the course of formal activities. Data on initial fawn production for deer were obtained in June during aerial and ground reconnaissance associated with fawn tagging. The river and reservoir ice was flown eight times (12-7, 12-21, 1-5, 1-13, 1-30, 2-7, 2-23, and 3-3) to check for coyote killed deer. Carcasses are listed as probable coyote kills based on evidence of tracks in the snow, trails of blood on snow or vegetation and other site evidence.

Seven adult mule deer were fitted with radio transmitter collars and nine mule deer with Armortite neck bands during winter 1977. Six adult mule deer were equipped with radio transmitters and one with a neck band during winter 1976 and were available for monitoring during this report period. Deer were captured either with a cannon net (Mackie et al. 1975) or by using a Cap-Chur gun fired from a helicopter. Aerial relocations of radio instrumented deer were obtained at 1-2 week intervals and relocations from the ground were made as often as possible.

Data on hunting mortality were collected from check stations on two major access roads during the first two weekends of the season, from field checks of hunters throughout the season and from voluntary hunter register boxes located along access roads.

Approximately 1 quart samples were obtained from rumens of deer killed by hunters, coyotes, and other undetermined causes for analysis of food habits.

Hydrothermographs were serviced weekly, rain gauges monthly and soil moisture readings were made at approximately two week intervals when the ground was not frozen.

STUDY AREA

The study area encompassed all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles in a 4 to 7 mile wide belt adjacent to the Missouri River in Fergus County, Montana (Fig. 1). It comprised approximately 100 square miles between U. S. Highway 191 on the west, the Skyline Trail on the east, the Missouri River on the north and the Musselshell Trail on the south. Physiography, climate, land use and vegetation of this area were described in detail by Mackie (1970). Some of the work described in this report was conducted on the adjacent Missouri River Bottomlands described by Allen (1968) and NE across the river on the Nichols Coulee Resource Conservation Area described by Knowles (1975).

POPULATION TREND

Table 1 lists early winter classifications of mule deer on the south side study area from 1960-61 through 1976-77. Mackie (1976) made population estimates and discussed population trend on the area based on these data. Figure 2 shows his trend estimate and extends the trend information through early winter 1976-77. This figure shows two population declines from 1960 to 1961 and 1964 to 1965. Population recovery generally started within two years after these declines. The population decline which started in the winter of 1971-72 has continued without recovery for five years. Early winter population estimates by Mackie (1976) place the 1976-77 population at about one-third of that during previous population highs in 1960, 1964 and 1970. Low fawn/doe and fawn/adult ratios (Tables 1 and 2) have been associated with the recent extended population decline. Spring classifications, the best available indicator of recruitment, were obtained only in 1972, 1976 and 1977. The recruitment apparent in the spring 1977 classifications (Table 2) should at least hold the population stable. A reasonable estimate of the spring 1977 mule deer population on the southside study area is 325, including approximately 57 males 1½ years and older, 193 females 1½ years and older and 75 fawns.

FAWN PRODUCTION AND MORTALITY

Table 3 lists the known ratio of fawns/100 producing females and estimates the ratio of fawns/100 females for the population as a whole in June and mid-July 1976 and 1977. The estimate of fawns/100 producing females was obtained from fawns observed with females during fawn capture in June and from those observed during aerial flights and ground observations in mid-July. The ratios for June are minimum estimates since some fawn mortality

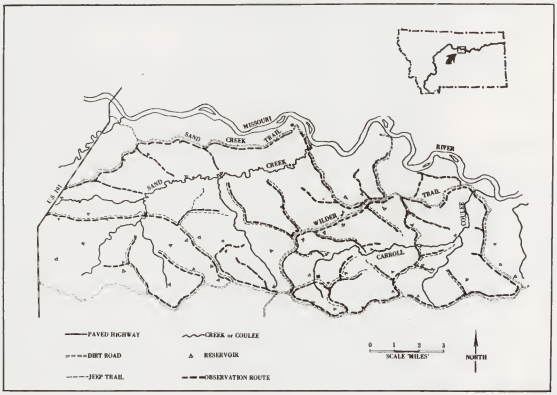


Figure 1. Map of the Study Area.

Table 1. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1975-76. Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg Males	
			Males	Female	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
1976-77	Aerial	258	17.4	57.4	25.2	30.4	43.9	33.6	40	

[1] Cumulative observations on area during December.
[2] All aerial observations by helicopter except 1969-70 (fixed wing aircraft).
[3] Only west half of area surveyed in 1967-68.

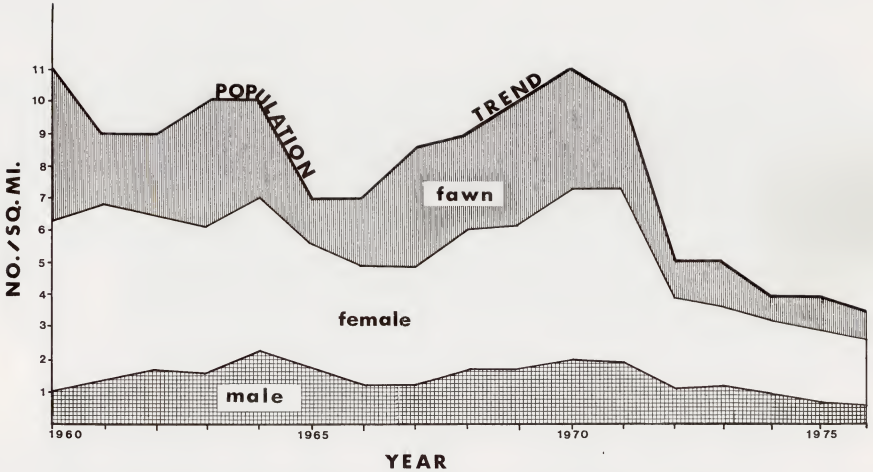


Figure 2. Population trend of mule deer on the Missouri Breaks Study Area, 1960-1976.

Table 2. Classifications and observed recruitment of fawns on the southside Missouri Breaks study area, 1975-76 and 1976-77.

Date	Total No.	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Ad.	Fawns/ 100 FF
Sept.-Oct. 1975	105	69	36	50	19	-	52	72
Dec. 1975	323	236	87	186	50	-	37	47
March 1976	193	173	19	-	-	-	11	-
Oct. 1976	159	110	49	79	31	-	45	62
Dec. 1976	258	193	65	148	45	-	34	44
Mar. 1977	293	225	68	-	-	-	30	-

Table 3. Estimated fawn/female ratios in June and mid-July 1976 and 1977.

	Fawns/producing female		Percent females producing		Estimated fawn/doe ratio
June 1976	150:100 (14)[1]	X	94[2]	=	141:100
July 1976	131:100 (16)	X	71.4[3]	=	94:100
June 1977	152:100 (27)	X	82[3]	=	125:100
July 1977	140:100 (20)	X	75.9[3]	=	106:100

[1]Female sample size in parenthesis.

[2]Percent female population older than yearling.

[3]Percent females observed alone or with fawns.

was known to have occurred during the June period in both years. The percentage of females observed alone or with fawns during June and mid-July was used as the percent of females producing. Since comparable data were not obtained in June 1976, the percentage of females older than yearling (from spring classifications) was used as the estimate of percent females producing. That this is a reasonable estimate is indicated by June 1977 data. At that time 85 percent of the female population was older than yearling, based on previous spring classifications; and 82 percent of the female population was observed alone or with fawns. It has been documented that females seek solitude to have their fawns (Einarson 1956), and observations on this area suggest that adult does normally do not associate with deer other than their fawns until at least August. This does not necessarily mean that females observed alone have or are going to have fawns, but those in groups with other females or males during early summer are probably not going to have fawns or lost them early. This technique may give a maximum estimate of the percent of females producing fawns at a given time period but may be countered by the minimum estimate of fawns/producing female.

Table 4 lists in utero ratios of fetuses/pregnant mule deer found in other areas. This information is not available for this study area, but it can be seen that figures for the southside study area of fawns/producing female

Table 4. In utero ratios of fetuses/pregnant doe found in four selected areas.

Source	Fetuses/pregnant doe
Nellis (1968)	
Nat. Bison Range (Montana)	1.67
Robinette et al. (1955)	
(Utah)	1.67
Julander et al. (1961)	
Sublette unit (Idaho)	1.85
Antimony unit (Utah)	1.33

on the ground in June are comparable to these in utero rates and are higher than the in utero rates observed by Julander (1961) for mule deer on the poor Antimony summer range. Information collected thus far indicate that female mule deer on the south side Missouri Breaks study area initially are near maximum potential productivity. If possible, however, information on in utero productivity should be collected on the study area.

The initial ratio of fawns/100 producing females was essentially the same in 1977 as 1976, however, the potential "observed" fawn/doe ratio at birth for the population was less (Table 3) because of increased fawn survival in 1976 over 1975 and hence a higher percentage of non-producing yearling females in the population.

Table 5 shows estimated and observed fawn/female ratios, fawn/adult ratios and estimated mortality rates during the period June 1976 to March 1977. During this time, the major fawn mortality period was from birth to early October. Substantial mortality also occurred from October to December, but very little mortality occurred over winter from December through March. Data were not obtained for all periods in 1975-76, but at that time the rate of fawn mortality was higher from December through March than from September - December, the reverse of that for 1976-77 (Table 2).

Known causes of fawn mortality will be discussed under the section on predation.

Table 5. Fawn mortality rates and periods of mortality June 1976-March 1977.

	Birth	Mid-July	Oct.	Dec.	Mar.
Fawns/100 Females	141	94	62	44	39[1]
Fawns/100 Adults	108[1]	68[1]	45	34	30
Approx. mortality rate	35%	35%	25%	10%	
Percent of total fawn mortality	45%	30%	20%	5%	

[1]Calculated based on percent males in population at that time.

HUNTING MORTALITY

Table 6 lists hunting statistics for mule deer in HD 410 and the research area. Average mule deer harvest in HD 410 declined 87 percent overall from the 1960-64 period to the 1976-76 period. The harvest level dropped considerably in 1965 from the harvest levels of the previous five years. This decline may be related in part to the mule deer population decline after the severe winter of 1964-65. The number of hunters also declined by almost one-half and undoubtedly also contributed to the decline in harvest. During the 1969-70 period the mule deer population was reported by Mackie (1976) to be at a level comparable to the 1960 and 1964 population levels. During this time, hunting seasons were essentially the same as in the 1960-64 period, but harvest was substantially lower. This lower harvest may be primarily related to the lower number of hunters. The declines in harvest since 1973 appear to relate primarily to the more restrictive seasons. Harvest declined by one-half when the bag was changed from two deer, either sex to one deer, either sex and by one-half again when changed to bucks only. In 1976, the known minimum harvest on the research area had declined to seven percent of the average known minimum harvest on the area during the 1960-64 period. Number of hunters checked at the opening day check station had declined to 20 percent of the average for the 1960-64 period (Table 6).

Hunting mortality should have been of negligible population consequence during 1975 and 1976 since only bucks could legally be taken. The fact

Table 6. Mule deer harvest statistics for HD 410 and the south side research area.[1]

Year	MD Bag Limit	410[2] Harvest	Hunters	Min. known kill on research area	Opening day check sta. HD 410 No. Hunters	Opening day check sta. HD 410 Kill
1959	2-ES	5,117	5,048			
1960	2-ES	5,769	6,486	150	407	129
1961	2-ES	5,951	7,091	151	224	70
1962	2-ES	5,964	6,482	81	350	70
1963	2-ES	6,683	5,925	37	89	37
1964	2-ES	6,800	6,860	73	117	55
1965	2-ES	2,945	3,680		141	26
1966	2-ES	4,086	4,468			
1967	2-ES	2,603	3,587			
1968	2-ES	3,061	4,031			
1969	2-ES	3,102	3,399			
1970	2-ES	3,271	3,774			
1971	2-ES	4,245	7,351			
1972	2-ES	3,050	7,385			
1973	1-ES	1,689	5,847			
1974	1-ES	1,531	5,614			
1975	1-MM only	890	-			
1976	1-MM only	738	2,742	7	48	4

[1]Point estimates for harvest from statewide hunter questionnaire.
[2]Data are for pre-1973 hunting district. HD 410 = present HD 410 + HD 417.

that only seven males were known to have been shot on the research area during 1976, indicates that in that year hunting also had a negligible impact on the male segment of the population.

During the period of restrictive hunting seasons, the mule deer population has declined, or at best, remained stable in some years. The observed low level of recruitment of fawns has not been enough to keep pace with the overall mortality rate of mule deer in this area.

PREDATION

Winter aerial population surveys of the Missouri Breaks study areas have indicated low to moderate mule deer fawn survival and/or production for the past six years. Initially, low ratios may have been related to the effect of the severe winter of 1971-72. During the last five years, however, spring-summer precipitation has been average or above and winters have been relatively mild. Because of this, a study was initiated in June of 1976 to investigate the possible role of coyote predation in low fawn survival in the Missouri breaks.

Knowles (1976) suspected substantial fawn mortality due to coyotes during summer and fall but had no documentation of causes of fawn mortality during this period. During winter, however, he obtained direct evidence of coyote predation as a proximal cause of mortality for both fawn and adult mule deer and white-tailed deer. Many of the kills found or observed were on river or reservoir ice, but kills were also found on bottomland and upland sites. The fact that four of five radioed adult mule deer on the north side study area were on upland sites when killed by coyotes indicated that deer were being killed on the uplands as well as on the ice. Without radioed animals, observability of carcasses and predation attempts is much less on upland sites than on river or reservoir ice. During winter 1975-76, Knowles (1976) found 66 (45 mule deer, 20 white-tailed deer and 1 unknown) probable coyote-killed deer on the river bottoms and north and south side study areas.

Tables 7 and 8 present a summary of probable coyote killed deer found during winter 1976-77. A total of 20 probable coyote-killed deer (16 mule deer and 4 white-tailed deer) were found. Figure 3 shows the location of kill sites and comparison to 1975-76 kill sites. Results for upland areas are not directly comparable to 1975-76 since most of the ground survey time was spent on the north side in 1975-76 and on the south side in 1976-77. One of nine radioed adult mule deer on the south side study area was a probable coyote-kill during winter 1976-77.

Overall fawn mortality was lower in 1976-77 than 1975-76 as evidenced by classifications (Tables 2, and 10). With more aerial reconnaissance during winter 1976-77 than during 1975-76, 70 percent fewer probable coyote killed deer were found.

Except for January (Table 9), the winter of 1976-77 was even milder than that of 1975-76. Both winters were milder than the 13 year mean. The ice went off the river and reservoir approximately 14 days earlier in 1976-77 than in 1975-76.

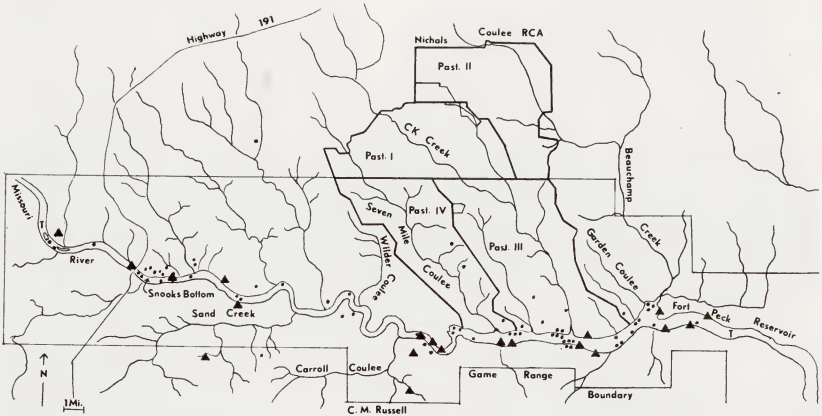
Table 7. Summary of probable coyote-killed deer, 1976-77.

	Mule Deer	White-tailed deer	Total
Overall Total	16	4	20
General Kill Site			
Reservoir Ice	9	0	9
River Ice	3	3	6
Bottom Lands	0	1	1
Uplands	3	-	3
Shore			
North	3	2	5
South	9	1	10
Sex			
Male	0	0	0
Female	1	0	1
Unknown	15	4	19
Age			
Fawn	2	0	2
Prime Adult	1	0	1
Old Adult	1	0	1
Unknown	12	4	16

Table 8. List and description of probable coyote-killed deer, Missouri Breaks, 1976-77.

Kill No.	Date	Spp.	Sex	Age	Habitat	Shore	Slope Exp.	Location	Comments
1	12/ 7/77	MD	U[1]	1/2	Pinus-Junip.	-	Level	NWS26T21NR24E	In bottom of small steep-sided coulee - radioed coyote near
2	12/ 7/77	MD	U	8+	River ice	So.	Level	NWS24T21NR26E	50 feet from shore
3	12/21/77	MD	U	U	Reservoir ice	So.	Level	SES17T21NR27E	20 feet from shore
4	12/21/77	MD	U	U	Reservoir ice	So.	Level	SWS11T21NR28E	50 feet from shore
5	1/ 5/77	MD	U	U	Reservoir ice	So.	Level	NWS24T21NR26E	100 feet from shore
6	1/ 5/77	MD	U	U	Reservoir ice	So.	Level	SES12T21NR28E	100 feet from shore
7	1/ 5/77	MD	U	U	Reservoir ice	No.	Level	NWS 7T21NR29E	100 feet from shore
8	1/ 5/77	MD	F	Ad	Sarc.-Art.	-	Coulee bottom	NES26T21NR26E	Radioed female
9	1/13/77	MD	U	U	Reservoir ice	No.	Level	SWS 2T21NR28E	50 feet from shore
10	1/13/77	MD	U	U	River ice	So.	Level	NES 1T21NR24E	10 feet from shore
11	1/30/77	MD	U	U	Reservoir ice	No.	Level	NWS18T21NR28E	50 feet from shore
12	1/30/77	MD	U	U	Reservoir ice	So.	Level	SWS17T21NR27E	At shoreline - 2 coyotes on carcass
13	1/30/77	MD	U	U	Pinus-Junip.	-	Coulee bottom	NES 2T20NR26E	Radioed coyote and 2 others at remains
14	1/30/77	WTD	U	U	Hayfield	-	Level	NWS21T22NR23E	---
15	2/ 7/77	MD	U	1/2	Shoreline	So.	20° N	SES18T21NR28E	Killed 100 feet above shoreline - 1 coyote on carcass
16	2/23/77	MD	U	U	River ice	So.	Level	NWS24T21NR26E	Old kill
17	2/23/77	WTD	U	U	River ice	No.	Level	SWS33T22NR24E	20 feet from shore
18	2/23/77	WTD	U	U	River ice	So.	Level	NWS31T21NR24E	50 feet from shore
19	3/ 3/77	MD	U	U	Reservoir ice	So.	Level	NES13T21NR27E	100 feet from shore
20	3/ 7/77	WTD	U	U	River ice	No.	Level	NWS 1T21NR24E	Old kill - 50 feet from shore

[1]U = Unknown.



Legend
Turn around points ____T.
Location of deer kill 1975-76 •
1976-77 ▲

Figure 3. Distribution and location of probable coyote killed deer, winters of 1975-76 and 1976-77.

Table 9. Mean monthly temperatures, precipitation and snowfall together with 13-year means for temperature and precipitation, November-April. U. S. Dept. of Commerce Weather Service Station Roy 24 NE (Mobridge), Montana.

Month	Temperature (Degree F) 1975-76	1976-77	13-year[1] Mean	Precipitation (inches) 1975-76	1976-77	13-year Mean	Snowfall (inches) 1975-76	1976-77
November	30.5	30.9	31.1	.63	.73	.38	13.7	8.5
December	20.6	27.3	18.3	.63	.10	.42	10.3	-
January	22.4	12.9	12.7	.17	.63	.55	3.1	13.6
February	32.9	36.3	24.2	.60	.23	.24	8.0	0.5
March	32.3	36.2	32.2	.57	.51	.57	7.3	5.0
April	49.0	51.2	45.0	.65	.17	1.21	2.0	0.5

[1]No data January and February 1964.

Table 10. Classifications and observed recruitment of fawns on the north side Missouri Breaks study area, 1975-76 and 1976-77.

Date	Total No.	Adults	Young	Females	Males	Fawns/ 100 Ad.	Fawns/100 Females
Sept.-Oct. 1975	84	62	22	36	26	36	61
Dec. 1975	208	172	36	119	53	21	30
Mar. 1976	115	109	6	-	-	5.5	-
Sept.-Oct. 1976	65	48	17	29	19	35	59
Dec. 1976	88	63	25	-	-	40	48
Mar. 1977	118	92	26	-	-	28	

During June 1976, 10 mule deer fawns were equipped with radio transmitters and one with an earflag on the south side study area as part of a graduate research project. Coyotes were implicated in at least some summer mortality of mule deer fawns during 1976. Four of the 11 fawns died between birth and early September (Dood, 1976 interim report). Two fawns were killed by coyotes as determined by hemorrhaging wounds and site evidence. Two were listed as probable coyote kills based on site evidence alone. Not enough of these two carcasses remained to determine if hemorrhaging wounds were present (Dood, 1976 interim report). Summer fawn mortality studies are continuing. The classifications indicate that fawn mortality also occurs during fall, but no data on causes has been collected to date. Radio transmitters with a longer life span were put on fawns during June 1977 and will hopefully help elucidate causes of fawn mortality during fall.

MOVEMENTS

A summary of minimum home ranges for mule deer on the south side study area is listed in Table 11. Only information on those deer marked during winter-spring 1976 is included in this report. Minimum home ranges ranged from 900 to 1,680 acres and averaged 1,222 acres for adult female mule deer. These home range sizes are considerably larger than the 300-400 acre home ranges reported by Mackie (1970) for mule deer on this same area. This discrepancy is probably due to the present use of radio telemetry as opposed to Mackie's (1970) use of earflagged deer with fewer reobservations made.

FOOD HABITS

Food habits data from rumen samples collected during the fall-winter period 1976-77 are presented in Table 12. Present fall food habits data are too limited at this time to allow comparison with Mackie's (1970) data of 1960-64. In general, however, data collected during winter 1976-77 indicated much greater use of Rubber rabbitbrush *(Chrysothamnus nauseosus)* and much less use of big sagebrush *(Artemisia tridentata)* than Mackie (1970) found in rumen samples during the 1960-64 period of high mule deer populations. Use of browse was higher and use of forbs and grasses lower during winter 1976-77 than during winter in the 1960-64 period.

DISCUSSION

Initial mule deer productivity appeared to be near species potential and substantially higher than the observed recruitment. In utero verification of the percentage of females producing fawns should be obtained. The problem, however, appears to be low fawn survival rather than low fawn production. During 1976-77, fawn mortality was highest from birth to early October and lowest during winter. During the previous year, fawn mortality was substantial during winter as well as during summer and fall. Coyote predation or probable coyote predation has been the major documented cause of fawn

Table 11. Home range size of radio marked mule deer on the southside Missouri Breaks.

Animal No.	Sex	Age	No. of Obs.	Lgth of Time Followed	Minimum Home Range		
					Acres	Hectares	Mi.^{2}
1-76	Stag	Mat.	44	16 months	3,380	1,368	5.3
2-76	F	Mat.	29	16 months	1,680	680	2.6
3-76	F	Mat.	58	15 months	1,315	532	2.1
4-76	F	Mat.	27	9 months	900	364	1.4
5-76	F	Mat.	46	15 months	1,230	498	1.9
6-76	F	Mat.	45	15 months	985	399	1.5
Ave. for females					1,222	495	1.9

mortality to date. However, sample sizes to date have been small and occurrence of mortality at or shortly after birth and causes of mortality from September through spring have not been well documented. Some fawns as well as adults were lost to probable coyote predation during winter as previously noted by Knowles (1976).

Hunting mortality at present is of negligible population consequence since the bag limit has been one deer, bucks only for the past two years. Hunting mortality of males was extremely low in 1976.

Fawn recruitment was higher and total known mortality, including predation, declined substantially in 1976-77 over 1975-76. Given continued low adult mortality and the fawn recruitment of 1976-77, the mule deer population should increase somewhat.

Information relating mule deer production and survival to coyote and small mammal population levels, forage production, livestock conflicts, climatic conditions and other factors will be included in future reports.

Table 12. Fall-winter food items in eleven mule deer rumen samples from the south side Missouri River Breaks.

Taxa	Oct. (1)[1]	Nov. (1)	Fall Season (2)	Dec. (3)	Jan. (4)	Feb. (2)	Winter Season (9)
GRASSES	tr.[2]	-	50/tr[3]	67/tr	25/tr	50/tr	44/tr
FORBS							
Artemisia longifolia	-	-	-	100/tr	25/19	-	44/8
Compositae	-	-	-	-	25/tr	-	11/tr
Melilotus officionalis	-	-	-	-	25/tr	-	11/tr
Phlox hoodii	-	-	-	33/tr	-	-	-
Yucca glauca	-	1	50/tr	-	-	-	-
Unid. forbs	tr.	20	100/10	-	25/tr	50/tr	22/tr
Total Forbs	tr.	21	100/10	100/tr	25/19	50/tr	44/9
BROWSE							
Artemisia tridentata	-	-	-	100/4	100/17	50/18	89/13
Atriplex nutalli	-	-	-	33/3	50/6	50/tr	44/4
Chrysothamnus nauseosus	85	48	100/67	100/58	100/26	100/28	100/37
Juniperus scopulorum	-	1	50/tr	100/19	100/15	100/21	100/18
Pinus ponderosa	tr.	tr	100/tr	-	-	-	-
Pseudotsuga menziesii	tr.	-	50/tr	-	-	50/2	11/tr
Rhus trilobata	-	tr	50/tr	67/5	75/12	100/5	78/8
Rosa spp.	5	tr	100/8	100/tr	-	-	33/tr
Salix spp.	-	tr	50/tr	-	-	-	-
Symphorocarpos spp.	9	29	100/19	100/10	100/5	100/26	100/11
Unid. browse	-	-	-	100/tr	-	-	38/tr
Total Browse	99	79	100/90	100/99	100/81	100/100	100/91

[1]No. of rumens.
[2]tr. = trace or < than 0.5 percent.

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Submitted by: Kenneth L. Hamlin

JOB TITLE: Population ecology and habitat relationships of white-tailed deer on bottomlands of the Missouri River in northcentral Montana, 1976-1977.

ABSTRACT:

Limited information was collected on a white-tailed deer population study initiated in late 1975 on the Missouri River bottom lands of northcentral Montana. White-tailed deer numbers have continued to decline since spring 1975-76. Though known hunting mortality was low, white-tailed deer numbers appeared to have already declined to a low level by fall or early winter 1976. Carcasses are hard to find in the heavy cover of the bottom lands, but four deer were known to have died during summer 1976 from an unknown disease. It is possible that numbers of deer lost to disease in summer 1976 may have been substantial. Disease loss on these bottomlands was previously documented in summer 1953 and 1962. Four white-tailed deer were known to have been lost to predation during winter 1976-77 as compared to twenty known lost to predation during winter 1975-76. Observations to date indicate that heavy late fall and winter use of bottom lands by cattle may preclude winter-spring usage by white-tailed deer.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer on bottomlands of the Missouri River in northcentral Montana, 1976-1977.

JOB OBJECTIVE: To determine the environmental requirements of white-tailed deer and factors regulating whitetail populations in major river bottom habitats of northcentral Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in northcentral Montana.

To develop new and improved guidelines for management of northcentral Montana whitetail populations and their habitats.

INTRODUCTION:

Few data are available on the population ecology and environmental requirements of white-tailed deer *(Odocoileus virginiana)* populations associated with the floodplains of major rivers in Montana. The only existing study (Allen 1968) was conducted in 1964-65 and primarily concerned range use, food habits, condition and productivity of white-tailed deer on bottomlands of the Missouri River in northcentral Montana.

To meet the need for further information concerning white-tailed deer in river bottom habitats, this study was established during 1975 on the same area on which Allen's (1968) study was conducted. Field studies were initiated during early winter 1975-76 and preliminary findings have been reported by Mackie and Knowles (1976). Due to low white-tailed deer population levels and other work demands field studies have not been intensive and were confined primarily to obtaining population data and deer distribution.

STUDY AREA

The study area is located on the Charles M. Russell Wildlife Refuge, administered by the U. S. Department of Interior Fish and Wildlife Service. The study area consisted of 20 bottoms and 3 islands included in a straight-line distance of about 23 miles (Fig. 1). The floodplain varied from 1/2 to 1 mile in width and bottoms, ranging in size from 144 to 644 acres, usually alternated between north and south sides of the river. The ridges overlooking the river are at approximately 2,900 feet elevation and slope at a relatively steep angle to the floodplain at approximately 2,270 feet.

Physiography, climate, land usage and vegetation of this area have been described in detail by Allen (1968). Mackie (1970) and Knowles (1975) provide similar information for adjacent uplands.

Figure 1. Map of study area.

METHODS

Existing data from prior management surveys and research studies on white-tailed deer on Missouri River bottoms were reviewed, analyzed and incorporated into the present report when applicable.

An early winter, December 2, 1976, aerial survey, employing a Bell Jet Ranger helicopter, was conducted to count and classify whitetails on the study area.

During January, 5 white-tailed deer were captured with a cannon net (Mackie et al. 1975) on Snooks bottom (5) and fitted with observation collars.

Periodic ground and aerial (Piper Supercub) observations were made throughout the year to determine movements, distribution, mortality and survival of white-tailed deer.

RESULTS

Population

Table 1 shows numbers and sex and age composition of white-tailed deer during the early winter (December 2, 1976) helicopter survey of the study area in relation to data for previous years. Although the number of white-tailed deer seen on the December 1976 flight was not an accurate population estimate, it is obvious that white-tailed deer numbers have continued the decline started in 1975-76. Population estimates for white-tailed deer on the study area during spring 1977 are shown in Table 2. The only reliable population estimate is that a minimum of 46 white-tailed deer were on the study area during spring 1977.

Table 1. White-tailed deer numbers, sex and age composition from early winter surveys 1960-1976.

Year	Numbers							Ratios				
	Tot.	AD	YG	Fem.	Males[1]	Yrlg	Mature	YG:100 AD	YG:100 FF	% YG	MM:100 FF	% YG MM
1960-61[2]	28	18	10	-	-	-	-	55.5	---	35.7	---	---
1961-62[3]	120	54	66	-	-	-	-	122.0	---	55.0	---	---
1962-63[4]	106	76	30	-	-	-	-	39.5	---	28.3	---	---
1964-65[5]	188	168	20	123	45	14	24	11.9	16.2	10.6	36.6	36.8
1965-66[6]	178	137	41	110	27	3	17	29.9	37.3	23.0	24.5	15.0
1966-67[7]	223	162	61	121	41	10	29	37.6	50.4	27.3	33.9	25.6
1971-72[8]	267	182	60	139	43	-	-	33.0	43.2	22.5	30.1	---
1973-74[9]	207	168	39	146	22	9	13	23.2	26.7	18.8	15.1	40.9
1975-76[10]	121	105	16	76	29	8	21	15.2	21.0	13.2	38.2	27.6
1976-77[11]	18	15	3	10	5	2	3	20.0	30.0	16.6	50.0	66.7

[1] Includes unclassified males.

[2] Sample classified ground late November - early January.

[3] Sample classified ground January 8 - January 12, 1963.

[4] Sample classified ground late November - early January.

[5] Helicopter survey December 29 and 30, 1964. Complete coverage also includes Grand Island.

[6] Helicopter survey December 30 and 31, 1965. Incomplete, Middle and Lower Units only.

[7] Helicopter survey December 19, 22 and 23, 1966. Incomplete, Middle and Lower Units only.

[8] Helicopter survey December 29, 1971. Complete.

[9] Helicopter survey January 1, 1974. Complete.

[10] Helicopter survey December 12, 1975. Complete.

[11] Helicopter survey December 2, 1976. Complete.

Table 2. Population estimates for white-tailed deer during Spring 1977.

Date	No. Deer Obs.	No. Marked Deer Obs.	Min. No. Unmarked Deer	Min. No. of Deer Marked	Lincoln Pop. Est.	Schnabel Pop. Est.	Minimum Pop. Est.
3-21-77	35	3	32	7	82	-	39
4-13-77	40	1	39	7	280	-	46
4-23-77	38	4	34	7	67	-	41
Mar.-Apr. 1977	113	8	-	7	-	99	-

Although sample sizes were small due to the low population level, fawn/adult and fawn/female ratios appeared to be higher initially and remained higher over winter during 1976-77 than during 1975-76 (Table 3). During 1975-76, only 11 of 28 deer marked in early winter were known to have survived through spring (Mackie and Knowles 1976). During 1976-77, at least 4 or 5 deer marked in early winter survived through spring.

A minimum of 90 white-tailed deer were known to have survived through March 1976 (Knowles pers. comm.), and at least some fawns were added to this total in early summer 1976. Subsequent population surveys indicated that there were probably substantially less deer than this by early winter 1976-77. Substantial mortality during summer and/or fall was indicated. Known mortality during summer and fall 1976 included at least 4 deer dying of disease and 3 killed by hunters. The extent of mortality by disease this past summer was not well documented; but it is possible that a substantial number of deer were lost to this factor on the study area. Winter-spring mortality included a minimum of 4 deer killed by coyotes and one dying from an accident. Winter predation on white-tailed deer was apparently substantially lower in 1976-77 (4 coyote-killed WTD found) as compared with that recorded by Knowles (1976) in 1975-76 (20 coyote-killed WTD found).

Table 3. White-tailed deer classifications and fawn survival during 1975-77.

Date	Tot.	Ad.	Yg.	Females	Males	Uncl.	Yg.:100 Ad.	Yg:100 Females
Dec. 1975	121	105	16	76	29	-	15	21
Mar. 1976	75	73	2	-	-	-	3	-
Aug. 1976	26	20	6	15	5	-	30	40
Dec. 1976	18	15	3	10	5	-	20	30
Mar.-Apr. 1977	75	58	12	-	-	5	21	-

Distribution

Mackie and Knowles (1976) noted that spring 1964 and 1975 were two years of major flooding of the river bottoms associated with increased reservoir levels. In 1975, water in Fort Peck reservoir rose to a record reservoir level and backed water up onto the lower Rocky Point bottom (15). Fawn/adult ratios were much higher before the 1964 flood (ave. 72 fawns/100 Ad.) than for the years between the 1964 and 1975 floods (ave. 31 f/100 Ad.). Also the fawn/adult ratio averaged only 14/100 during the two flood years. They concluded that flooding of the bottomlands in June was at least partially responsible for low fawn/adult ratios indirectly through habitat loss and possibly through direct fawn mortality.

Table 4 shows winter and winter-spring distribution of white-tailed deer by unit and bottom during years when complete surveys were made. A progressive decline in the percentage of total deer observed on the lower bottoms was noted. After the 1975 flood, no deer were seen on the Rocky Point bottoms (13 and 15) or below. The percentage of deer observed on the Upper and Middle bottoms rose during this same period, however, the number of deer on these upper bottoms did not increase in relation to the loss of deer from lower bottoms. The deer previously occupying the lower bottoms (30-50% of the total) apparently were not incorporated into populations occupying bottoms in the Upper and Middle Units, but were lost entirely.

The only bottoms where winter-spring deer use was not recorded during any survey were bottoms 3 and 12 (Table 4). Bottom 3 has always received heavy winter use by cattle during these years. Bottom 12 has received heavy late fall and early winter use by cattle.

DISCUSSION

With limited data presently available, no detailed statement can be made regarding the interrelations of factors affecting white-tailed deer on the study area. However, at least four factors influencing white-tailed deer population declines on the area can be recognized. A major factor is the periodic flooding of some bottom lands and permanent inundation of other bottoms by rising reservoir levels. White-tailed deer habitat has been completely destroyed on many lower bottoms and the deer previously occupying these bottoms were not assimilated into populations above the flooded areas. Agricultural crop species and practices and livestock grazing practices change with time, flooding, economy and management practices. This in turn affects white-tailed deer habitat and food supplies. White-tailed deer apparently will not use bottoms during winter with heavy winter cattle concentrations. Coyote predation in combination with other factors may contribute to declines in deer number during some years. Disease, which may have been a major decimating factor during the summer of 1976, was also reported to have results in deer mortality on the area during late summer and early fall 1953 (Chaffee 1954) and 1962 (Foss and Rognrud 1962), suggesting that it may be a recurring decimating factor.

Table 4. White-tailed deer distribution during winter and spring, 1964-77, listed by percent of total per Bottom, Island or Unit.

Date	No. of Obs.	Bottom Number (See Fig. 1)																					
		1	Two Calf Isl.	2	3	4	5	6	7	Harriet Isl.	8	9	10	Isl.	11	12	13	14	15	16	17	18	19	20
Winter-Spring 1964-65	535	4	Tr	1	-	6	-	3	1	2	2	29	2	Tr	2	-	Tr	1	10	15	10	2	6	4
Winter 1971-72	267	3	-	4	-	Tr	9	9	8	3	-	17	6	5	-	-	15	-	20	Tr	-	-	-	-
Winter 1973-74	207	4	-	5	-	4	4	4	46	2	-	-	-	-	10	-	19	-	3	-	-	-	-	-
Winter 1975-76	121	18	-	7	-	-	44	12	-	-	-	12	-	-	7	-	-	-	-	-	-	-	-	-
Winter-Spring 1976-77	131	16	-	24	-	-	2	18	4	11	-	25	1	-	-	-	-	-	-	-	-	-	-	-

Date	No. of Obs.	Upper Unit	Middle Unit	Lower Unit
Winter-Spring 1964-65	535	11	39	48
Winter 1971-72	267	7	51	35
Winter 1973-74	207	13	56	32
Winter 1975-76	121	25	68	7
Winter-Spring 1976-77	131	40	61	0

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Submitted by: Kenneth L. Hamlin

JOB TITLE The effect of coyotes on mule deer production in the Missouri Breaks.

ABSTRACT

Summer siren surveys in 1976 averaged 3.4 responses per station on the South Missouri Breaks and 2.8 on the North Missouri Breaks. Late winter 1976-77 siren surveys averaged 0.9 responses on both areas, indicating a possible coyote population reduction approximating 71 percent of the summer population. Five coyotes were trapped and telemetered in 1976-77. Den ranges of two denning coyotes (1 male, 1 female) averaged 2.39 sq. mi.; travel ranges of two nondenning coyotes (1 male, 1 female) averaged 43.71 sq. mi. Ten coyotes were trapped and telemetered in 1977; two subsequently died of trap related injuries. An estimate of the "minimum known population" for the primary deer study area indicated 69 coyotes (34 adults and 35 young) or a density index of 60 coyotes/100 sq. mi.

Job Title — The effect of coyotes on mule deer production in the Missouri Breaks.

Job Objective — The general objective of this study is to determine the relation between coyote density and predatory losses of mule deer to coyotes. The specific objective is to determine whether a 50 percent reduction in coyote density will result in an increase in mule deer fawn survival.

INTRODUCTION

An intensive study of mule deer production in the Missouri Breaks was initiated in 1975 following previous deer-elk-livestock studies in the South Missouri Breaks (Mackie 1970) and North Missouri Breaks (Knowles 1975, Komberec 1976).

The original research plan was divided into coyote and deer study phases; however, following numerous observations of coyote predation on deer in the Missouri Breaks, (Knowles 1976, Dood 1976), additional emphasis was placed on coyote ecology beginning in the spring of 1976.

This report presents the data collected relative to coyote populations in the Missouri Breaks from summer 1976 to July 1, 1977. Coyote research requiring laboratory facilities (analyses of scats, stomachs, reproductive tracts, and teeth) is reported elsewhere (Schladweiler 1977). Hamlin (pp 95 - 101 in this report) discussed observations of deer kills on the ice of Fort Peck Reservoir.

Craig Knowles and Ken Hamlin did considerable work on coyotes during the year and collected much of the data presented here.

STUDY AREA

The Missouri Breaks study area is located on both sides of the Missouri River in northcentral Montana (Fig. 1). Vegetation, topography, land use, and wildlife have been discussed in detail by Mackie (1970), Knowles (1975), and Komberec (1976).

During much of the year, while ice-free, the Missouri River apparently is a barrier to normal coyote movements. Territories and social associations established during the spring-summer-fall reproductive season, probably restrict winter movement of coyotes across the river on the ice. High coyote densities on both sides of the river could also inhibit movement across the river. Dispersal of coyotes (mainly young) appears to be away from the river and toward the sagebrush-grassland plains bordering the breaks toward the north and south.

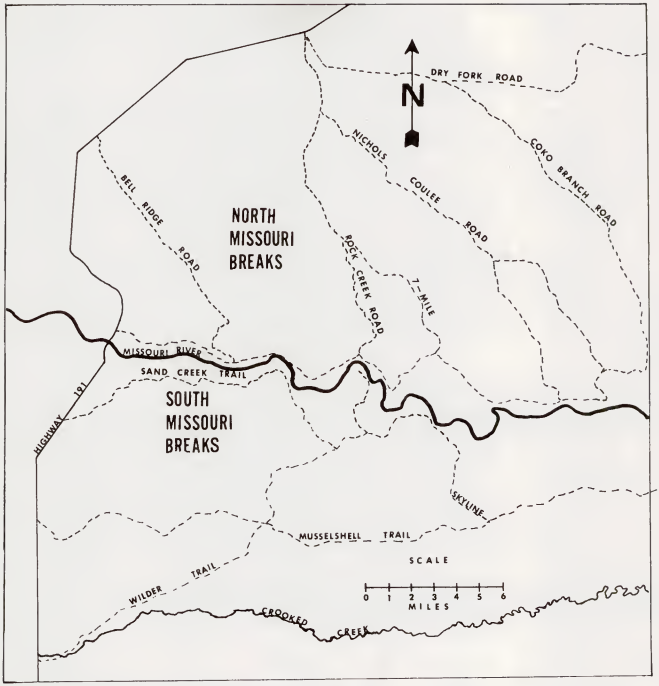

Figure 1. The Missouri Breaks coyote study area.

South Missouri Breaks

The South Missouri Breaks includes approximately 200 sq. mi. in northeastern Fergus County, extending north to south from the Missouri River to Crooked Creek and west to east from Highway 191 to the Skyline Trail (near the Fergus-Petroleum county line). Radio telemetry studies and scent post and siren answer surveys were conducted on this portion of the study area. Coyotes will be controlled during the 1978-79, 79-80, and possibly 80-81 fall-winter-spring periods.

The Musselshell Trail divides the South Missouri Breaks into: 115 square miles of fir-pine-juniper "breaks" along coulee side slopes and "finger ridges or benches", and 85 square miles of continuous sagebrush plains, extending to Crooked Creek and beyond. The coulee breaks, along with their interspersed finger ridges, make up the primary coyote and deer habitats. The continuous sagebrush-grassland plains provide primary habitat for antelope and secondary habitat for coyotes and deer. Coyote control will be extended to the plains to provide a buffer zone around the primary deer habitat.

Livestock grazing is the principal commercial land use and recreational pursuits of hunting, fishing, and camping are the important noncommercial public uses. The area adjacent to the Missouri River lies within the Charles M. Russell Wildlife Range administered by the U. S. Fish and Wildlife Service. Public lands over the remainder of the Area are administered by the U. S. Bureau of Land Management through the East Indian Butte Grazing District.

North Missouri Breaks

The North Missouri Breaks coyote study area includes approximately 280 square miles in southwestern Phillips County extending south to north from the Missouri River to the Dry Fork Road and west to east from Highway 191 to Coko Branch Road (CK ridge). Major drainages are longer north of the Missouri River, increasing the distance between the river and the first east-west road 14 miles from the river. Otherwise, vegetation, land ownership, and land use are similar. The Nichols Coulee and Square Butte Resource Converstion Areas include a portion of the Charles M. Russell Game Range north of the Missouri River.

Scent post and siren surveys were conducted on the North Missouri Breaks. Coyotes will not be controlled in this area except as typically required to protect livestock.

METHODS AND PROCEDURES

Some procedures are still in the formative stages since this is the first year of this research.

General Observations

Locations of coyotes were recorded during all other phases of field activities. These activities included helicopter deer surveys, fixed wing aerial location of fawns, livestock and deer, and ground travel for deer trapping, fawn tagging, radio relocations, den watching, coyote trapping, etc.

Scent Post Surveys

Scent post surveys were conducted in May and September, 1976, using standard U. S. Fish and Wildlife Service materials and procedures (Roughton 1976). Fifty scent post stations were placed at 0.3-mile intervals along the Wilder Trail - Rocky Point Road on the South Missouri Breaks, and along the Nichols Coulee Road on the North Missouri Breaks (Fig. 1).

Siren Answer Surveys

Siren answer surveys also followed U. S. Fish and Wildlife Service procedures with some slight modifications. Siren surveys included the following roads: 1) Wilder-Sand Creek and 2) Musselshell-Skyline within the South Study Area; and 3) Nichols-7 Mile, and 4) Bell Ridge-Rock Creek on the North Study Area.

Listening stations were 3 miles apart. Listening radius was assumed to be 1.5 miles and the listening area at each station was 7.07 sq. mi. The survey was done from midnight, sometimes slightly before, until 3 to 4:30 a.m. The listening time varied, depending upon the number of coyotes which answered. Listening was continued for 2 full minutes following each siren wail if no answers were heard. Jim Hoover, U. S. Fish and Wildlife Service supervisor in Billings, recently recommended an increase in the listening time. Listening was continued until all answering coyotes were identified, or until they ceased to call. This time sometimes exceeded 5 minutes. The objective of the survey was to record a response from as high a percentage of the coyotes within listening range as possible; therefore, the time interval was adjusted toward that objective. The siren was placed on a moveable platform so it could be rotated toward each side of the truck. Directing the siren in a quartering direction should reduce the bias or distortion of the listening radius caused when the siren is pointed directly ahead each time.

Recorded coyote calls on casette tapes have been obtained and will be used on these routes with a similar procedure if preliminary tests indicate that recorded calls are equal to or better than the siren.

Trapping

Initial trap sets were made by U. S. Fish and Wildlife Service trappers Dale Meeks in 1976 and Dennis Abbey in 1977. Traps were subsequently reset

and moved to new locations by project personnel. Traps were #3, double-spring, leg-hold, coyote traps with off-set jaws. The setting procedure was similar to that described by Young (pp:187-193 *In:* Young and Jackson 1951). Coyote urine and other scents were used as attractants.

A handling procedure was developed which allowed safe handling with a minimum of risk or difficulty. The procedure consisted of: 1) placing a pole-choke noose over the coyote's head, usually causing it to lay down; 2) placing a canvas over the coyote; 3) moving the hand along the back of the head to the muzzle on the outside of the canvas; 4) grasping the muzzle shut; 5) pulling the canvas back to expose the bare muzzle; 6) taping (3M electrician plastic tape) the muzzle closed; and 7) taping the three free feet together. The caught foot was then released and the coyote could be handled safely and conveniently without tranquilizer or anaesthetic injection.

Radio Telemetry

VHF radios (AVM Electronics Co.) were potted in dental acrylic and attached to Koroseal (Goodyear) collars as designed by Schladweiler in 1976. Fur around the neck was clipped with scissors to make the collar fit better. The collar was fastened together with pop rivets.

Radio locations were made from ground and air. Aerial locations were on a 1 to 2 week basis. Ground locations were mostly made while working on another activity.

Aerial locations were made using the small yagi antenna taped to the airplane wing strut. Earphones were worn by both the pilot and the observer. Coyotes were not always observed; however, their location was determined into a very small area by the strength of the radio signal.

Population Estimates

Population estimates for the South Missouri Breaks were made by combining observations from several sources: 1) all adult coyotes observed associated with pups and/or dens, 2) dens and/or pairs with marked coyotes, 3) coyotes trapped and marked compared with unmarked coyotes, 4) all known dens from observations supplemented by group answers to the siren (thought to include pups), 5) all coyotes observed from air and ground during the period of fawn tagging, and 6) average number of young in complete litters.

RESULTS AND DISCUSSION

General Observations

A total of 217 coyotes was observed during the year; however, their distribution has not been plotted. Six litters recorded in 1976 averaged 4.2 young and ranged from 3 to 7. In 1977, five observed litters averaged 3.2 young and ranged from 3 to 4.

Scent Post Surveys

The results of the 1975 and 1976 scent post surveys were reported previously (Schladweiler 1977). A future report will contain the results of all scent post surveys made since 1975.

Siren Answer Surveys

Results of 1976 summer siren surveys (Table 1) indicated an average response (minimum coyote density) of 3.4 per station in the South Missouri Breaks (40 station counts), 2.8 in the North Missouri Breaks (20 station counts), and 3.2 (3.1 arithmetic mean) for both sides combined (40 stations and 60 station counts). Density indices (coyotes/100 sq. mi.) were: 47 (south), 40 (north), and 45 (combined).

Results of winter siren surveys (Table 2) indicated a possible reduction of approximately 71 percent - to 0.9 responding animals per station and density indices of 13 (south), 12 (north), and 12 (combined).

We are working on a method to compare known numbers of coyotes in the South Missouri Breaks with siren responses during winter and summer. Known adults can be compared with the winter siren responses and the summer total compared with the summer siren responses. Some professional coyote callers believe that coyotes answer less during late winter than during summer. If so, winter mortality estimates based on the difference in response between summer and late winter might be overestimated. For 34 adults surviving to the summer of 1977, the calculated density was 2.09 per station. We heard an average of 0.9 calling animals per station. Thus, siren responses were heard from 43 percent of the actual coyotes. More refinement of useable stations for this analysis will be needed to apply it to the summer siren routes.

Trapping

Five coyotes were captured and radio-collared in April 1976. Ten were trapped and radio-collared in April-May 1977 (Table 3); three more coyotes were in traps, but escaped. Two nonlactating females died after being trapped, presumably due to trap-related injuries.

The ratio of females to males was the same both years: 2 of 5 in 1976 and 4 of 10 in 1977. Den coyotes were trapped near den locations or near litter observations. Significantly more den males than females were captured. Future trapping efforts will be directed toward known den areas located in 1976 and 1977.

The significance of a low ratio of lactating females in 1977 and a reduced average litter size cannot be evaluated at this time.

Radio Telemetry

Four of five 1976 radios were monitored throughout the summer. One radioed coyote was shot in October (Phillips male, Fig. 2); one was trapped and

Table 1. Results of summer siren surveys, Missouri Breaks Study Area, 1976.

	Date of Survey	Single Calls	Multiple Calls	Estimated Total	Number of Stations	Average No. calls/ Station	Density Index/ 100 sq. mi.
South Side							
Wilder-Sand Creek	7/8	22	7	29	10	2.9	41
	8/4	14	20	34	10	3.4	48
Total		36	27	63	20	3.2	45
Musselshell-Skyline	7/15	17	18	35	10	3.5	50
	7/23	9	27	36	10	3.6	51
Total		26	45	71	20	3.5	50
South Total		62	72	134	40	3.4	47
North Side							
Nichols-7 Mile	7/16	17	23	40	12	3.3	47
Rock Creek-Bell Ridge	9/29	5	12	17	8	2.1	30
North Total		22	35	57	20	2.8	40
GRAND TOTAL		84	107	191	60	3.2	45

Table 2. Results of winter siren surveys, Missouri Breaks Study Area, 1976-77.

	Date of Survey	Single Calls	Multiple Calls	Estimated Total	Number of Stations	Average No. calls/ Station	Density Index/ 100 sq. mi.
South Side							
Wilder-Sand Creek	2/27	3	4	7	11	.7	9
Musselshell-Skyline	2/20	4	10	14	10	1.4	20
	3/8	5	0	5	7	.7	10
Total		9	10	19	17	1.1	16
South Total		12	14	26	28	0.9	13
North Side							
Nichols-7 Mile	3/5	2	6	8	8	1.0	14
Rock Creek-Bell Ridge	3/2	2	4	6	10	.6	8
North Total		4	10	14	16	.9	12
GRAND TOTAL		16	24	40	44	.9	13

Table 3. Summary of coyotes trapped, South Missouri Breaks, 1976-77.

Year	Sex	Radio	Status	Remarks
1976				
Sand Creek Trail	Female-L[1]	I-3.25	Den	Trapped 1/30/77
Phillips Coulee	Male	I-6.25	Den	Shot 10/6/76
Skyline	Male	I-12.25	No Den	
Carroll	Female-NL	I-8.25	No Den	
Crooked Creek	Male	I-4.4	No Den	
1977				
Sand Creek Trail	Male	II-7.15	No Den	
Upper Sand Creek	Female-NL	I-5.3	No Den	
Sagebrush Pasture	Male	II-10.4	Den	
Carroll Crossing	Male	II-3.3	Den	
Upper Dobbs	Female-NL	II-12.25		Died
Crooked Creek	Female-NL	II-1.3		Died
Gumbo	Female-L	I-10.5	Den	
Haines Coulee	Male	I-7.4	No Den	
Lances Ridge	Male	II-9Q	No Den	
Green Ridge	Male	I-9Q	Den	

[1]L = lactating; NL = nonlactating.

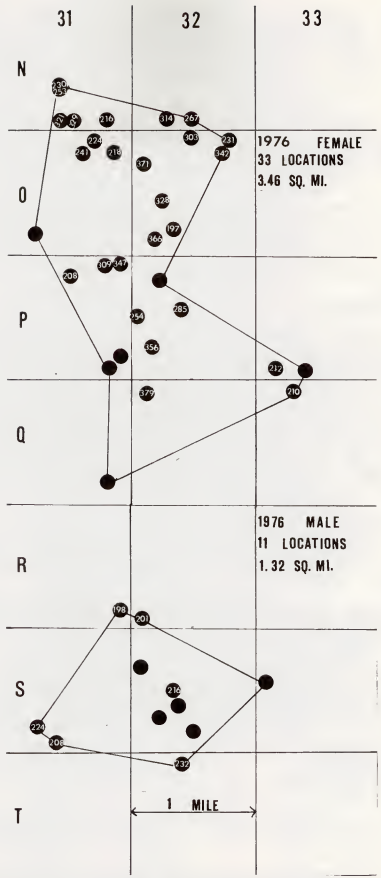

Figure 2. Ranges of two radioed denning coyotes in 1976.

killed by a rancher during January (Sand Creek lactating female); a signal from one was heard only sporadically during spring and fall (Crooked Creek male); and two were monitored throughout winter (Skyline male, and Carroll dry female, Figure 3). Both coyotes which were killed were associated with dens during 1976. None of the other coyotes were known to be associated with dens.

Den ranges of the two den coyotes ranged from 1.32 (April-August) to 3.46 (April-December) square miles and averaged 2.39 square miles. The yearly ranges of the two nondenning coyotes were 35.81 and 51.62 square miles averaging 43.71 square miles.

The obvious movement differences between denning and nondenning coyotes, shown in Figures 2 and 3, represent differences associated with social organization. This information should help in the analysis of the total population.

Population Estimates

The observations of dens, pairs, and radio marked animals indicated a minimum spring population of 34 adult coyotes in 1977 (Table 4). Eleven dens were located during summer 1977. Five complete litters were observed, averaging 3.2 young per litter. Assuming that this average applies to all dens, the 34 adults would have produced 35 young. Thus, the minimum 1977 summer population was approximately 69 total coyotes in 115 square miles. The estimated density of coyotes then is approximately 69/115 (100) = 60 coyotes per 100 square miles. The 1977 siren survey indicated a lower population in the summer of 1977 than in 1976. Thus a slightly higher density probably existed in 1976.

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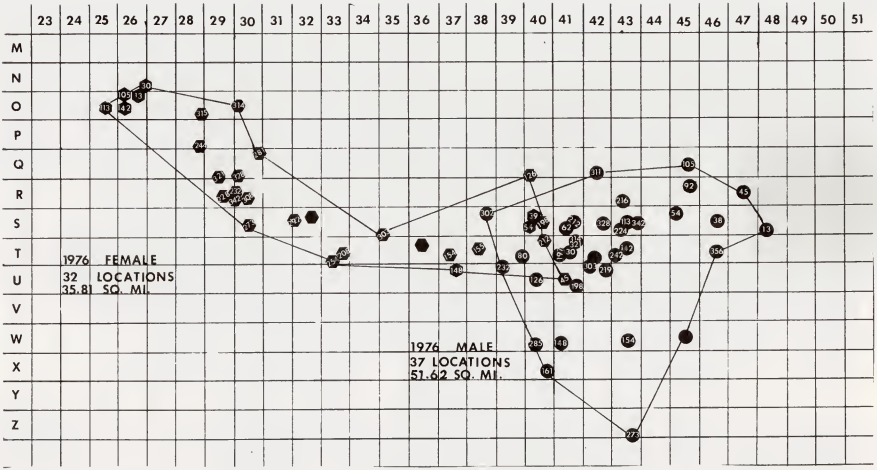

Figure 3. Ranges of two radioed nondenning coyotes during 1976-77.

Table 4. Minimum probable coyote population, South Missouri Breaks, summer 1977.

Den No.	Location	Litter Young	Den Adults M[1]	Den Adults U[1]	Other Adults M	Other Adults U	Total Coyotes
1	Upper Sand Creek	3		2	1		6
2	Sagebrush Pasture	3	1	2		1	7
3	Phillips Coulee	(3.2)[2]		2			5.2
4	Six-Mile	3	1	1			5
5	Skyline	3		3	1		7
6	Carroll Crossing	4	1	1			6
7	Pierce Pasture	(3.2)[3]		3			6.2
8	Gumbo	(3.2)	1	(1)[2]	1		6.2
9	Mathison	(3.2)		2			5.2
10	Johnson-Rocky Point	(3.2)		(2)	2	2	9.2
11	Highway Grade	(3.2)		(2)	1		6.2
	TOTALS	35.2	4	21	6	3	69.2[4]

[1]M = Marked; U = Unmarked.
[2]( ) Estimated, not observed; 3.2 average for 5 complete litters observed.
[3]One pup actually observed.
[4]69 coyotes/115 square miles = 69/115 (100) = 60 coyotes/100 sq. mi.

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Submitted by: Duane B. Pyrah

Job Title: Effects of coyote predation on mule deer fawn survival in the Missouri Breaks.

Job Objective: Radio-mark newborn mule deer fawns and monitor their locations daily, determining the causes of any mortalities during summer and early fall.

Introduction

In recent years observed mule deer fawn production during early winter in the Missouri River Breaks (northcentral Montana) has been low to moderate despite average or above spring-summer precipitation and mild open winters (Mackie 1976). Similar situations for mule deer have been documented in other areas of western United States (Trainer 1975, Anderson 1976, Knowles 1976). During 1975-1976 predation by coyotes on mule deer fawns in the Missouri River Breaks was suspected during fall as observed from declining fawn:doe ratios and actually documented during winter (Knowles 1976). No intensive work to determine extent and causes of fawn mortality from summer to fall has been conducted in this area. This study was initiated in the summer of 1976 to account for summer fawn mortality by use of radio telemetry. Special emphasis was placed on predation by coyotes.

Description of Study Area

The study area has been described by Mackie (1970). The south boundary, however, was extended seven miles to Crooked Creek to provide an equal area of prairie habitat.

Methods

An intensive effort to mark mule deer fawns was made from June 14 to June 26, 1976. Fawns were located from ground and aerial surveillance. From two to four ground crews of one to two people each were afield during most morning and evening periods during the period of tagging operations. A fixed wing aircraft (Piper Super Cub) was also used on approximately seven mornings and three evenings to aid in locating fawns. Radio transceivers were used to coordinate field efforts.

Fawns were captured with the aid of long-handled hoop nets. Captured fawns were marked with radio transmitters and ear tags or ear tags and streamers. Sex and weight was noted for each fawn and a hair sample from the shoulder area was removed for protein analysis. Radios of frequency range 150-151 MH_z were equipped with mercury and thermal switches. The radio transmitter and lithium battery were attached to an expandable, elastic neckband and then sealed in dental acrylic. An external whip antennae 2 dm. long extended from the radio package. The entire radio collar weighed approximately 81 grams. Ground tracking of fawns was done by use of a 12-channel AVM Model LA12 radio receiver and a directional two-element Yagi antennae. Radio marked fawns were located on a daily basis; visual contact was

established at four-day intervals. Activity, habitat type, slope, exposure, group associations and conditions of the fawn were recorded for each visual sighting. A relocation was considered as visual sighting. On locating a fawn carcass the area was searched for tracks and scats and a detailed written report of carcass appearance and damage, if any, was made. Photographs were taken of the carcass before being necropsied.

Fawn home ranges were calculated using the modified minimum area method (Knowles 1975).

Various aspects of cover were measured at selected fawn bedding sites. Canopy coverage for grass, forbs and shrubs by decimeter height classes was measured with a 4 x 10 dm. Daubenmire frame (Daubenmire 1959). Ten plots at three-meter intervals were placed along two bisecting right angle 15-meter lines at each site. Horizontal cover of total vegetation was measured at decimeter height classes with a vertically placed 3 x 10 dm. cover board. Eight readings at 45° intervals were made with the observer standing 6 m. away from the cover board.

Results

Habitat Types

Mackie (1970) described eight major habitat types for this section of the breaks. During this study classification to habitat types followed Mackie.

Tagging

Observations of 11 females with 17 fawns during the tagging period (June 14-26) led to 8 actual attempts to capture 12 fawns of which 11 were caught and marked.

Movements

Movements and area used varied considerably among the marked fawns; maximum and minimum movements were 2.35 mi. and .025 mi., respectively. Home range size appeared to be partly related to the number of relocations. Fawns which were followed for only a short period of time generally used smaller areas. Radioed fawns were capable of extensive movements very early in life.

Use of Habitat Types

Habitat use by the fawns varied from heavy use of Artemisia-Agropyron (26.6%) and Pinus-Juniperus (48.1%) in the first half of summer to almost exclusively Pseudotsuga-Juniperus (87.5%) in the second half. Exposures used varied accordingly, with south facing slopes and aspects in the first half of summer and north facing slopes and aspects during the second half. Use of slope varied considerably throughout the summer.

Fates

Two of the radio-marked fawns were killed by coyotes. Hemorrhages in the head and shoulder regions below bite marks were used as criteria of violent death (White 1973). Two other fawns were probable coyote kills; not enough of the carcasses remained to confirm violent deaths. However, the similarities between sites (tracks, fur from coyotes on vegetation in the area, matted vegetation around the kill, blood on the collar and tooth marks on the antennae) of the two known coyote kills and sites of death for the two other fawns indicated coyotes were probably involved. Both of these fawns were observed alive one day previous. All four known fawn mortalities occurred from 10 to 36 days after being marked. None of these fawns exhibited any signs of poor condition prior to their death. The fate of one fawn remained undetermined. The radio ceased functioning after six days. The cause of the malfunction was not determined nor was the fawn ever reobserved. Another fawn lost its collar 46 days after it was marked. Radios ceased functioning on the four remaining fawns from 54 to 88 days after being marked.

Discussion

The fact that four of the nine fawns for which fates were established died as a result of probable predation within 36 days of being marked suggested summer fawn mortality may be substantial. Nutritive failure was not believed to be a cause in any fawn deaths; Verme (1963) found this generally occurred within 48 hours after birth.

These data help substantiate and partially explain observations made by Knowles (1976) in this area the previous year; that is, initial fawn production for producing females was relatively high in June, but by winter fawns:doe ratios declined to low to moderate values.

Due to the availability of only one summer's data no conclusion will be drawn at this point. The study will be continued in the summer of 1977 and the sample size will be increased. It is hoped this increase will allow for a better understanding of the extent of fawn mortality due to predation by coyotes.

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Prepared by: Arnold R. Dood

JOB TITLE: Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana.

ABSTRACT:

Population dynamics, hunting mortality and browse utilization of mule deer *(Odocoileus hemionus)* and white-tailed deer *(Odocoileus virginiana)* on the Terry study area during 1976-77 are discussed and compared with findings in 1975-76. Population estimates indicate an approximate 40% increase in winter mule deer numbers in 1976-77 over 1975-76. Very low or no hunting mortality and high overwinter survival were probably major factors involved in the extent of the increase. Classifications indicate that either producing mule deer females lost substantial numbers of fawns between birth and September, some adult females did not produce at all, or both. Some mule deer fawn mortality occurred between late September and January. As in 1975-76, overwinter mortality of deer appeared to be very low in 1976-77. Population estimates indicate an approximate 30% decrease in white-tailed deer numbers on the study area. Most of this decrease occurred on the northern portion of the study area and may be related to the deer "die off" that occurred in several areas of the state during summer 1976. Winter and spring fawn/adult ratios during 1976-77 for white-tailed deer were comparable to those in 1975-76. Hunting pressure and hunting mortality on the study area were substantially below that of recent years. Browse utilization on areas inhabited primarily by mule deer increased substantially during 1976-77 over 1975-76 on rubber rabbitbrush *(Chrysothamnus nauseosus)* and chokecherry *(Prunus virginiana)* and to a lesser extent on the other browse species sampled. Number of new pellet groups recorded on these transects increased substantially in 1977 over 1976. Browse utilization and number of pellet groups on transects in areas inhabited primarily by white-tailed deer showed a stable to slightly downward trend. It is believed that two transects are too few to adequately reflect white-tailed deer population trends.

Job Title: Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana.

Job Objective: To determine the environmental requirements of mule deer and white-tailed deer and factors regulating deer populations in prairie-agricultural habitats in eastern Montana.

To determine the effects of various potentially competing land use and management practices upon deer in eastern Montana.

To develop new and improved guidelines for management of deer populations and their habitats in eastern Montana.

INTRODUCTION:

The Terry deer study was initiated in September 1975 as a part of the statewide deer research project. The general objective was to determine factors affecting and limiting mule deer *(Odocoileus hemionus)* and white-tailed deer *(Odocoileus virginiana)* numbers in the prairie/agricultural types of eastern Montana. Field studies were conducted from September 1975 through May 1976, after which, fieldwork was continued on a part-time basis. During 1976-77 studies were limited to: 1.) aerial surveys to make population estimates and follow population dynamics; 2.) measurements of browse utilization; and 3.) determination of hunting mortality.

STUDY AREA

The study area is located in north Prairie and southwestern McCone counties on the west side of highway 253, starting approximately 10 miles northwest of Terry and extending north to approximately 4 miles south of Brockway. The study area extends as far west as Little Sheep Mountain on the southern boundary and 5 miles west of Brockway on the northern boundary (Fig. 1). Approximately 230 square miles are included within the study area boundaries.

A general description of the topography, vegetation, land uses and history was included in the previous report (Hamlin 1976).

METHODS

Fixed-wing (Piper Super Cub) aerial surveys were made to obtain population estimates and classifications during three periods: pre-hunting season (September); post-hunting season (January) and spring (March). In addition, flights were made in July to obtain early estimates of numbers of fawns per producing female.

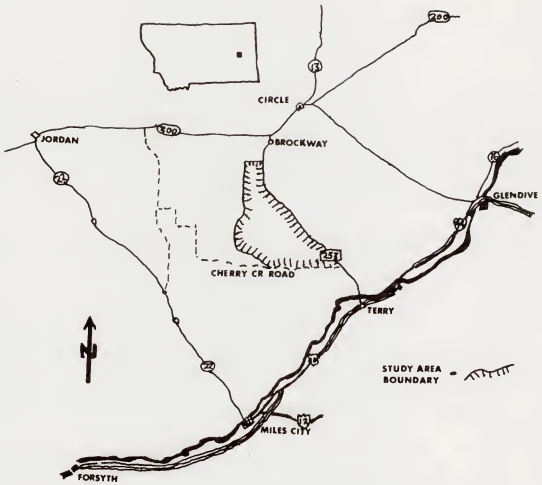

Figure 1. General location of the study area.

Hunting season statistics were determined by a telephone survey of the holders of 50 special either sex-either species permits, the statewide questionnaire and rancher interviews.

Eight previously established browse transects were examined to obtain the percent utilization of the number of available leaders (Cole 1958). Transect lines varied from ¼ to 2 miles in length and a variety of browse plants were randomly sampled as they were encountered along transect lines. Recent deer pellet groups were recorded as encountered along transect lines.

RESULTS

Population Trend

Table 1 lists classifications during 1976-77 within the study area. Classifications for 1975-76 are listed in Table 2. The January count and classification was the only intensive, full coverage survey this year. Snow and temperature conditions during the January flights this year were excellent and the January count may be considered a population estimate. The September flights did not cover the study area completely and the March flights, while full coverage, were less intensive than the January flights.

Flights were made over the area in late July to determine the ratio of fawns per producing female. At that time, 10 female mule deer with 14 fawns were found, for a ratio of 140 fawns/100 producing females. Too few white-tailed females were observed to develop a reliable ratio.

Assuming that all yearling female mule deer did not produce fawns and that last spring's classifications provide a reliable estimate of the percentage of yearling females in the population, the expected fawn/female ratio was much higher than the ratio observed during the September flights. The expected fawn/female ratio for mule deer in September was 110 fawns/100 females and the observed ratio was 71 fawns/100 females. Either producing females lost substantial numbers of fawns between birth and late September or some adult females did not produce at all, or both.

The mule deer fawn/female ratio was higher in early fall 1976 than in fall 1975. However, by January and March 1977, ratios had dropped to only slightly above those for comparable periods of the previous year. As in 1975-76, overwinter mortality appeared to be very low (Tables 1 & 2).

The ratio of fawns to adults in March 1977 was higher than that in January (Table 1). This discrepancy is believed to be due to the less intensive March 1977 flights in which many more of the smaller groups of deer were missed than was the case for the other flights listed (Table 3). These were all intensive, full coverage flights. Previous observations on the study area and other areas indicated that many of these smaller groups were adult males. If a high proportion of adult males were not included in the classification, this would explain the inflated fawn/adult ratio in March over January.

TABLE 1. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL 1976 AND WINTER AND SPRING 1977.

	Species	Total Animals	Total Males	Ylg. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
September aerial										
	WTD	25	3	2	13	16	7	2	44	54
South area	MD	101	17	9	45	62	32	7	52	71
	WTD	49	17	5	19	36	11	2	31	58
North area	MD	24	7	5	10	17	7	-	41	70
	WTD	74	20	7	32	42	18	4	43	56
Entire area	MD	125	24	14	55	79	39	7	49	71
January aerial										
	WTD	77	8	4	28	36	18	23	50	64
South area	MD	210	34	17	103	137	57	16	42	55
	WTD	83	-	-	-	27	25	31	93	-
North area	MD	42	6	3	21	27	15	-	56	71
	WTD	160	-	-	-	63	43	54	68	-
Entire area	MD	252	40	20	124	164	72	16	44	58
March aerial										
	WTD	44	-	-	-	25	19	-	76	-
South area	MD	154	-	-	-	103	51	-	50	-
	WTD	42	-	-	-	28	14	-	50	-
North area	MD	13	-	-	-	7	6	-	86	-
	WTD	86	-	-	-	53	33	-	62	-
Entire area	MD	167	-	-	-	110	57	-	52	-

TABLE 2. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL AND WINTER 1975 AND SPRING 1976.

	Species	Total Animals	Total Males	Ylg. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
Pre-season ground & aerial										
South area	WTD	76	13	-	28	41	32	3	78	114
	MD	125	25	-	54	79	31	15	39	57
North area	WTD	43	8	-	14	22	18	3	80	129
	MD	49	3	-	31	33	16	-	49	52
Entire area	WTD	119	21	-	42	63	50	6	78	119
	MD	174	28	-	85	113	47	15	42	55
December aerial										
South area	WTD	83	10	7	34	44	26	12	59	76
	MD	117	9	7	71	80	37	-	46	52
North area	WTD	146	19	9	68	86	53	7	62	78
	MD	35	3	2	22	25	11	-	44	50
Entire area	WTD	229	29	16	102	130	79	19	61	78
	MD	153	12	9	93	105	48	-	46	52
April aerial										
South area	WTD	87	-	-	-	46	36	5	78	-
	MD	108	-	-	-	74	34	-	46	-
North area	WTD	146	-	-	-	84	62	-	73	-
	MD	26	-	-	-	12	9	5	75	-
Entire area	WTD	233	-	-	-	130	98	5	75	-
	MD	134	-	-	-	86	43	5	50	-

TABLE 3. A COMPARISON OF GROUP SIZES OF MULE DEER WITH INTENSITY OF COVERAGE OF FLIGHTS.

Date of flights	Type of coverage	Ave. group size	Percent of groups with 5 or less deer
December 1975	full & intensive	6.91 (22 groups)	54.5
April 1976	full & intensive	6.45 (20 groups)	50.0
January 1977	full & intensive	7.20 (35 groups)	51.4
March 1977	full but not intensive	9.30 (17 groups)	29.4

Fawn/female and fawn/adult ratios for white-tailed deer were unaccountably lower during fall 1976 than during fall 1975. In view of the subsequent January and March 1977 classifications, the fall 1976 ratios probably were inaccurate. Fawn/adult ratios for January and March 1977 are comparable to last years ratios.

The difference in the maximum winter count of mule deer for 1976-77 (252) and 1975-76 (153), for the entire area, is greater than can be accounted for by addition of fawns, even with no hunting mortality. However, if this years count, under exceptional conditions, is used as a standard 100 percent count and the 1975-76 count is estimated to include about 85 percent of the total mule deer on the area (Hamlin 1976), the two population estimates are quite comparable when mortality and fawn production are included. Computations involved in comparison of the population estimates are shown in Table 4. Comparison between subdivisions of the area between years are not as good. These subdivisions are "paper" subdivisions and are probably not real for the deer. Movement of the deer between these subdivisions probably negates year-to-year population comparisons between subdivisions.

The population estimates indicated an approximate 40 percent increase in mule deer numbers during the past year. The percentage of yearling and older males in the post-hunting season population increased from 8 percent in 1975-76 to 17 percent in 1976-77. This, together with the overall population increase and the fact that fawn recruitment appeared to be about the same as in 1975-76 would suggest that lack of hunting mortality was a major factor in the increase.

The maximum number counted is used as the population estimate for white-tailed deer. Due to a greater use of denser cover by white-tailed deer the count is necessarily a minimum population estimate. The population estimates for white-tailed deer indicated an approximate 30 percent decrease in total number on the area from 1975-76 to 1976-77. Nearly all of this decrease occurred in the northern, more agricultural portion of the study area (Tables 1 and 2). During summer 1976, a deer "die off" especially affecting white-tailed deer, was noted in various portions of the state. One of the areas hardest hit was an area around Circle which is approximately 15 airline miles east of the northern boundary of the study area. Although I did not directly observe deer mortality on the study area, one rancher on the area reported seeing several dead white-tailed deer during summer. Also, three marked adult female white-tailed deer known to have been on the study area in May 1976 have not been observed during subsequent aerial and ground work and were not reported to have been shot by hunters. Causes of the "die offs" have not been fully determined. Factors being pursued as possible causative agents include: disease, especially virus diseases; pesticide poisoning related to grasshopper control and ingestion of naturally toxic plant species due to drier conditions than normal.

TABLE 4. OBSERVED AND CALCULATED POPULATION ESTIMATES FOR MULE DEER ON THE TERRY STUDY AREA.

Method & Time	Total Animals	Adults	Fawns	Females	Males
observed winter 1975-76	153	105	48	93	12
+ 15% missed	180	124	56	109	15
			↳ +	28	28
calculated June 1976	180	180	-	137	43
			X	.58	--58 fawns/100 ♀♀ observed winter 1976-77
				79 fawns	
calculated winter 1976-77	259	180	79	137	43
Observed * winter 1976-77	252	175	77	132	43

* Includes the addition of 16 unclassified animals in proportion to the various classes in the population

Hunting Season and Harvest

The boundaries of the hunting unit (HD 731) which includes the study area were changed prior to the 1976 hunting season; thus statewide questionnaire figures for 1976 are not directly comparable to previous years. It appears, however, that numbers of hunters and the number of deer killed, both white-tailed and mule deer, decreased considerably from recent years. The bag limit in effect for the study area was also changed during 1976. From 1971 through 1974 the limit was two deer, either sex, either species. In 1975, the limit was two deer either sex, B tag white-tailed deer only. In 1976, the past hunting season, the bag limit was one deer, either sex, white-tailed deer only. In addition there were 50 either sex, either species special permits which allowed the taking of a mule deer. A telephone survey of 36 special permit holders who could be reached, showed that 13 were not successful, 3 shot a white-tailed deer in another hunting unit, 5 shot a mule deer female in HD 731, 12 shot a mule deer male in HD 731 and 3 shot a white-tailed deer male in HD 731. None of the deer shot in HD 731 were shot on the study area. Expanding these data to the entire 50 permits resulted in an estimated 24 mule deer shot in HD 731. The statewide questionnaire returns produced a very comparable estimate of 27 mule deer shot in HD 731. This would indicate that no mule deer or only a very few were shot on the study area.

Two of the ranchers on the study area issued permission slips to all people who wanted to hunt on their ranches during 1975. Seventy-eight parties totaling 245 people hunted on these two ranches that year. In 1976 only 5 parties hunted on the ranch that had 31 parties during the previous year; while the other rancher, who had 47 parties on his land in 1975, said that he had so few parties in 1976 that he didn't bother to issue permission slips. Interviews with other ranchers on the study area also indicated that hunting pressure had dropped substantially over previous years.

Browse Utilization

Table 5 lists percentages of leaders (current annual growth twigs) used on eight browse transects during 1975-76 and 1976-77. The degree of utilization (i.e. length of leaders used) was not measured. At least some use of browse by cattle occurred on all transects, but no attempt was made to quantify cattle use as opposed to deer use. On areas inhabited primarily by mule deer, rubber rabbitbrush *(Chrysothamnus nauseosus)* showed increased usage on each transect and use for all transects combined increased from 44% in 1975-76 to 71% in 1976-77. Use on chokecherry *(Prunus virginiana)* increased from 8% in 1975-76 to 28% in 1976-77. Overall use increased slightly on silver sagebrush *(Artemisia cana)* and on the one transect on big sagebrush *(Artemisia tridentata)*. The slight increase in the use of skunkbush sumac *(Rhus trilobata)* was insignificant.

The number of new pellet groups encountered along transect lines increased for each transect in areas of predominantly mule deer use and by 115%

Table 5. Browse use during 1975-76 and 1976-77.

Trans. No.	Year	Number of new Pellet Groups	*Chrysothamnos nauseosus*		*Artemisia cana*		*Rhus trilobata*		*Prunus virginiana*		*Symphoricarpos* spp.		*Rosa* spp.		*Artemisia tridentata*	
			Number of Plants	Percent leaders used	Number of Plants	Percent leaders used	Number of Plants	Percent leaders used	Number of Plants	Percent leaders used	Number of Plants	Percent leaders used	Number of Plants	Percent leaders used	Number of Plants	Percent leaders used
333	1976	104	104	68.4	89	12.3	78	2.7	34	1.6	-	-	-	-	61	2.1
	1977	152	139	86.7	62	25.7	53	8.8	50	17.4	-	-	-	-	52	6.1
345	1976	19	105	18.9	45	6.5	21	1.7	-	-	-	-	-	-	-	-
	1977	48	156	34.4	50	3.2	22	0.5	-	-	-	-	-	-	-	-
400	1976	37	76	55.7	-	-	-	-	-	-	-	-	-	-	-	-
	1977	53	97	85.0	-	-	-	-	-	-	-	-	-	-	-	-
444	1976	25	111	33.7	48	4.0	33	2.1	29	2.2	-	-	-	-	-	-
	1977	120	141	79.5	51	11.2	39	1.8	38	39.9	-	-	-	-	-	-
454	1976	11	62	44.2	-	-	65	0.9	-	-	-	-	-	-	-	-
	1977	22	78	71.6	-	-	69	0.4	-	-	-	-	-	-	-	-
456	1976	52	88	45.2	113	8.9	52	4.3	31	19.8	-	-	-	-	-	-
	1977	139	122	79.1	115	13.8	63	4.0	43	30.6	-	-	-	-	-	-
All MD Areas	1976	248	546	43.6	295	8.6	256	2.7	94	7.8	-	-	-	-	61	2.1
	1977	534	733	71.1	278	14.0	246	3.3	131	28.2	-	-	-	-	52	6.1
399	1976	83		-	-	-	-	-	30	35.7	107	40.8	102	22.2	-	-
	1977	53	-	-	-	-	-	-	39	49.9	106	49.4	74	19.2	-	-
499	1976	22	-	-	-	-	-	-	103	23.4	44	8.6	-	-	-	-
	1977	29	-	-	-	-	-	-	102	37.3	89	6.3	-	-	-	-
All WTD Areas	1976	105	-	-	-	-	-	-	133	26.2	151	29.6	102	22.2	-	-
	1977	82	-	-	-	-	-	-	141	40.8	195	29.7	74	19.2	-	-

from 1975-76 for all transects. This, together with increased browse utilization and higher aerial population estimates provides substantial indication of increased mule deer numbers on the study area.

The two transects on areas used mainly by white-tailed deer showed no change in the level of utilization of snowberry *(Symphorocarpos* spp.), a slight drop in the utilization of rose *(Rosa* spp.) and an increase in the use of chokecherry. However, these two transects, probably are not adequate to measure and monitor changes in use on the area affected by white-tailed deer on the study area.

The number of new pellet groups stayed about the same on one and decreased on the other transect in areas of white-tailed deer use in 1976-77 as compared to 1975-76. There was a 22% decrease in number of new pellet groups from 1975-76 for both transects combined.

The technique employed for measuring browse utilization, as described in the methods section, seemed to have distinct advantages over the twenty-five plant Cole (1958) transects on the study area. Transects vary from ¼-2 miles in length and sampled a wider area. This may reduce the effect of variation in use of individual small areas by deer from year-to-year and is more efficient in areas where individual browse plants are widely scattered. Also, a much greater number of individual plants as well as different species of plants can be sampled on each transect. A total of 1,638 different plants were sampled in spring of 1976 and 1,850 were sampled in 1977; a number equivalent to 74 twenty-five plant Cole (1958) transects. Although some of the same plants are not sampled each year, the total number of plants sampled gives a good representative sample. Five hundred forty-six rubber rabbitbrush plants, the major species sampled, were read for utilization in 1976 and 733 plants were read in 1977. This is equivalent to 22 and 29 Cole transects respectively. Problems with these browse transects are that horizontal juniper *(Juniperus horizontalis),* a major species used by deer on this area cannot be sampled, that there is an unknown and variable amount of cattle use on browse and that browse is only one of many factors affecting and responding to deer population levels. Also, once browse use on any species reaches a measurable maximum, no further upward change in level of use can be determined since length of leader used is not measured. These browse transects may be effective at low deer densities only. I feel that this information is valuable, however, as long as it is used as only one of several indicators of deer population levels and condition.

Marked Deer

At the time fulltime field studies were terminated last year, movements information was being obtained on 2 radioed white-tailed deer, 1 neckbanded white-tailed deer and one radioed mule deer. Since that time the area has been covered four times aerially and from the ground. The radioed mule deer was relocated once and the white-tailed deer were not relocated.

LITERATURE CITED

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Submitted by: Kenneth L. Hamlin

Job Title: Statewide Deer Carcass Collection

ABSTRACT:

A total of 197 white-tailed and 75 mule deer carcasses was examined between 1 July 1976 and 30 June 1977, the second year of the statewide deer carcass collection. The majority of the carcasses were collected in winter and early spring. Seventy percent of the white-tailed deer and 20 percent of the mule deer were collected west of the Continental Divide. Road kills accounted for 75 and 68 percent of the mortality for white-tailed and mule deer, respectively. Twenty nine, 49 and 22 percent of the white-tailed deer carcasses examined were fawns, adult females and adult males, respectively. For mule deer, these figures were 38, 39 and 23 percent, respectively. Percent pregnancy, percent twins, litter size and fetuses: 100 females examined all appeared to increase from fawns to yearling and from yearlings to females 2.5 and older for both white-tailed and mule deer. In utero production was 1.83 and 1.80 fetuses per pregnant female for white-tailed and mule deer, respectively. Ovarian analysis did not reveal any substantial loss of ova and/or fetuses from conception until death during pregnancy for females of both species of deer. For both white-tailed and mule deer, males dominated the in utero sex ratio while for adults, females dominated.

Job Title: Statewide Deer Carcass Collection

Objectives: To determine the number and distribution of deer killed along roads and highways in Montana; and to determine and compare basic or potential reproductive rates for both species in major habitat types across the State.

INTRODUCTION:

The Winter-Spring 1976 marked the beginning of an intensive statewide effort to collect reproductive, condition and food habits information on white-tailed and mule deer. Record of certain biological material were obtained for all dead deer found throughout the year dying from causes other than hunting. Mackie (1976), when reporting on the first statewide carcass collection, noted several reasons why information of this nature was vital to proper deer management in Montana. Of primary importance was the comparison of potential reproduction to realized reproduction on a region wide habitat basis. Variations in reproductive potential between regions and overtime can only be documented through consistent, systematic, and intensive collections over a span of several years. This report, for the second year of the statewide deer carcass collection, summarizes cause of death, age and sex distribution and analysis of reproductive tracts for all deer found dead between 1 July 1976 and 30 June 1977.

PROCEDURES

Procedures, with the exception of food habits, followed those described by Mackie (1976). The food habits aspect of the study during 1976-77 was deleted due to lack of interest, work overloads and personnel shortages.

Ovulation rates were determined by the number of corpora lutea per ovary. This value was then doubled to give corpora lutea per pregnant female. This was done because several of the reproductive tracts had one ovary lost or destroyed.

RESULTS

White-tailed Deer

During the report year 1976-77 data were collected from 197 white-tailed deer carcasses. This figure was only 33 percent higher than the previous year even though the period of collection was about twice as long in 1976-77. About 70 percent of the carcasses were collected between 1 January 1977 and 30 April 1977 (Table 1). Only seven carcasses were collected in August and September despite the fact that a considerable number of white-tailed deer died during this period apparently as a result of disease (Hamlin 1977).

Table 1. Number and percentage distribution by month for collection of 197 white-tailed deer carcasses during 1976-77.

Month	No.	Percentage
January	28	14
February	29	15
March	56	28
April	26	13
May	10	5
June	7	4
July	2	1
August	5	3
September	2	1
October	5	3
November	10	5
December	17	8

The relatively low number of deer for which data were collected during this period was probably due to the failure of Department personnel to either fill out the proper forms when deer dead from disease were found or to investigate all reports of deer dying from disease.

Seventy percent of the deer were collected west of the Continental Divide, about the same as the year previous. Road kills accounted for about 75 percent of the mortality (Tables 2 and 3). This was similar to the results of 1975-76.

Table 4 shows the distribution of numbers of deer collected by age and sex for each Administrative Region. For carcasses in which age was determined, 28, 17 and 55 percent of the females were fawns, yearling and adult, respectively (Table 5). These figures for males were 46, 21 and 33 percent, respectively. The oldest female was 10+ while the oldest male was 4.5.

Table 2. Numbers, cause of death and distribution of kill by Administrative Region and statewide for 197 white-tailed deer carcasses found July 1, 1976 to June 30, 1977.

Region	Cause of Death						
	Road-Kill	Predation	Illegal-Kill	Trap Casualty or Collected	Other	Uncl.	Total
1	71	2	3	4	2	8	90
2	39	0	3	1	0	4	47
3	3	0	0	0	0	0	3
4	26	0	0	0	0	1	27
5	6	0	0	0	0	0	6
6	2	0	0	0	3	0	5
7	0	0	0	17	1	1	19
Statewide	147	2	6	22	6	14	197

Table 3. Percentage distribution of cause of death by year for white-tailed deer carcasses found from December 1975 through June 30, 1977.

Year	Cause of Death					
	Road-Kill	Predation	Illegal-Kill	Trap Casualty or Collected	Other	Uncl.
1975-76	77	8	5	2	8	-
1976-77	75	1	3	11	3	7
Combined Years	76	4	3	8	5	4

Table 4. Number distribution of 197 white-tailed deer carcasses by age, sex and Administrative Region.

Age	FEMALES Region 1	2	3	4	5	6	7	State-wide Total	MALES Region 1	2	3	4	5	6	7	State-wide Total	Combined Statewide
.5	9	7		8	1		2	27	15	8		1	1	1	1	27	54
1.5	8	5	1	3				17	8	1				1	2	17	29
2.5	6	7					6	19	3	3	1	1	1		1	10	29
3.5	9	4		2	1	1		17	3	1		1				5	22
4.5	2	1		3			3	9	1	1		1			1	4	13
5.5	2			2				4									4
6.5	1					1		2									2
7.5																	
8-10	1						1	2									2
11+							2	2									2
Uncl. Ad.	10	6		3				19	7	1			1			9	28
Uncl. Age	2	1			1	1		5									5
TOTAL	50	31	1	21	3	3	14	123	37	15	1	4	3	2	5	67	190

Uncl. Age & Sex							
3	1	1	2				7

Table 5. Percentage distribution of age by sex and area for 157 assigned age white-tailed deer carcasses.

Age	West of Divide			East of Divide			East & West Combined		
	FF	MM	Comb.	FF	MM	Comb.	FF	MM	Comb.
.5	26	52	37	30	30	30	28	46	34
1.5	21	20	20	11	16	12	17	21	19
2.5	21	14	18	16	30	20	19	17	19
3.5	21	9	16	11	8	10	17	9	14
4.5	5	5	5	16	16	16	9	7	8
5.5	3	0	2	5	0	4	4	0	3
6.5	2	0	1	3	0	2	2	0	1
7.5	0	0	0	0	0	0	0	0	0
8-10	1	0	1	3	0	2	2	0	1
11+	0	0	0	5	0	4	2	0	1

Distribution by age (Tables 4 and 5) shows that for white-tailed deer collected in 1976-77 very few individuals lived past five years of age for both males and females east and west of the Divide. Percentages of young, adult females and adult males east and west of the Divide were quite similar in 1976-77 and for both years combined (Table 6). These figures between years for west of the Divide were remarkably similar (Table 6). The differences recorded between years east of the Divide can probably be accounted for, more so, by the large and diverse nature of the area sampled than by any actual changes in population characteristics. Dusek's collection in the Long Pines in 1976-77, which was largely adult females, had a decided influence on the fawn:doe ratio obtained for that year. In 1976-77, percent pregnancy, in utero production and ovulation rates in each age class, where sample size was sufficient, appeared to be somewhat similar between collections from east and west of the Divide; and all were relatively high (Table 7). Combined data for 1975 through 1977 showed similar results (Table 8). On a statewide basis percent pregnancy increased from 25 percent for fawns to 95 percent for females 2.5 and older (Table 8). Percent single litters decreased from 100 percent for fawns

Table 6. White-tailed deer carcass numbers, classification, ratios and percentages by area and statewide for 1975-76, 1976-77 and combined.

Year / Area	Numbers					Ratios			Percentages		
	Tot.	Ad.	Yg.	FF	MM	Yg:100 Ad.	Yg:100 FF	MM:100 FF	% Yg	% FF	% MM
1975-76											
West of Divide	84	59	25	40	19	42.3	62.5	47.5	29.8	47.6	22.6
East of Divide	34	21	13	15	6	61.9	86.7	40.0	38.2	44.1	17.6
Statewide	118	80	38	55	25	47.5	69.1	45.4	32.2	46.6	21.2
1976-77											
West of Divide	130	91	39	62	29	42.8	62.9	46.8	30.0	47.7	22.3
East of Divide	55	40	15	29	11	37.5	51.7	37.9	27.3	52.7	20.0
Statewide	185	131	54	91	40	41.2	59.3	43.9	29.2	49.2	21.6
Combined Years											
West of Divide	214	150	64	102	48	42.7	62.3	47.1	29.9	47.7	22.4
East of Divide	89	61	28	44	17	45.9	63.6	38.6	31.4	49.4	19.1
Statewide	303	211	92	146	65	43.6	63.0	44.5	30.4	48.2	21.4

Table 7. Summary of white-tailed deer reproductive data for 1976-77.

Area Age Class	Tot. Deer Exam.	No. Preg.	Litter Size Sgl.	Twins	Trip.	Sex of Fetus FF	MM	Uncl.	Percentages Litter Size % Preg.	% Sgl.	% Twins	% Trip.	Sex % FF	% MM	Ratios Fetuses/ Preg. FF	Corpora Lutea/ Preg. FF	Fetuses: 100 FF Examined
West of Divide																	
.5	1	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
1.5	9	7	2	5	0	5	3	4	78	29	71	0	63	37	1.71	2.00	133
2.5+	24	23	4	18	1	15	22	6	96	17	78	5	41	59	1.87	2.19	179
Uncl. Ad.	6	6	2	3	1	3	6	2	100	33	50	17	33	67	1.83	4.00	183
Total Ad.	39	36	8	26	2	23	31	12	92	22	72	6	43	57	1.83	2.20	169
Total Deer	41	36	8	26	2	23	31	12	88	22	72	6	43	57	1.83	2.20	169
East of Divide																	
.5	5	2	2	0	0	2	0	0	40	100	0	0	100	0	1.00	2.00	100
1.5	2	2	2	0	0	1	1	0	100	100	0	0	50	50	1.00	1.00	100
2.5+	14	14	2	9	3	5	20	4	100	14	64	22	20	80	2.07	2.09	207
Uncl. Ad.	1	1	0	1	0	2	0	0	100	0	100	0	100	0	2.00	2.00	200
Total Ad.	17	17	4	10	3	8	21	4	100	23	59	18	28	72	1.94	2.00	194
Total Deer	22	19	6	10	3	10	21	4	86	31	53	16	32	68	1.84	2.00	159
Combined Areas																	
.5	6	2	2	0	0	2	0	0	33	100	0	0	100	0	1.00	2.00	33
1.5	11	9	4	5	0	6	4	4	81	44	56	0	60	40	1.55	1.78	127
2.5+	38	37	6	27	4	20	42	10	97	16	73	11	32	68	1.94	2.10	189
Uncl. Ad.	7	7	2	4	1	5	6	2	100	29	57	14	45	55	1.85	2.67	185
Total Ad.	56	53	12	36	5	31	52	16	95	23	68	9	37	63	1.87	2.12	176
Total Deer	62	55	14	36	5	33	52	16	90	26	65	9	39	61	1.83	2.12	162

Table 8. Summary of white-tailed deer reproductive data for combined years of 1975-76 and 1976-77.

Area / Age Class	NUMBERS: Tot. Deer Examined	No. Preg.	Litter Size: Sgl.	Twins	Trip.	No. Fetuses	PERCENTAGES: % Preg.	Litter Size: % Sgl.	% Twins	% Trip.	RATIOS: Fetuses/ Preg. FF	Fetuses: 100 FF Examined
West of Divide												
.5	7	1	1	0	0	1	14	100	0	0	1.00	14
1.5	15	13	7	6	0	19	87	54	46	0	1.46	126
2.5+	43	42	9	31	2	77	98	21	74	5	1.83	179
Uncl. Ad.	6	6	2	3	1	11	100	33	50	17	1.83	183
Total Ad.	64	61	18	40	3	107	95	29	66	5	1.75	167
Total Deer	71	62	19	40	3	108	87	31	64	5	1.74	152
East of Divide												
.5	5	2	2	0	0	2	40	100	0	0	1.00	40
1.5	3	3	3	0	0	3	100	100	0	0	1.00	100
2.5+	21	19	3	13	3	38	90	16	68	16	2.00	181
Uncl. Ad.	1	1	0	1	0	2	100	0	100	0	2.00	200
Total Ad.	25	23	6	14	3	43	92	26	61	13	1.87	172
Total Deer	30	25	8	14	3	45	83	32	56	12	1.80	150
Combined Areas												
.5	12	3	3	0	0	3	25	100	0	0	1.00	25
1.5	18	16	10	6	0	22	88	62	38	0	1.38	122
2.5+	64	61	12	44	5	115	95	20	72	8	1.89	179
Uncl. Ad.	7	7	2	4	1	13	100	29	57	14	1.85	185
Total Ad.	89	84	24	54	6	150	94	29	64	7	1.78	168
Total Deer	101	87	27	54	6	153	86	31	62	7	1.76	151

to 20 percent for females 2.5 and older. Fetuses per pregnant female examined were 1.00, 1.38 and 1.89 for fawns, yearlings and females 2.5 and older, respectively.

There is some evidence from both years that considerable mortality occurs in fawns between parturition and their first winter. Combined data for both years showed in utero production to be 168 fetuses:100 adult reproductive tracts examined (Table 8). The fawn:doe ratio obtained from the carcass collection for both years averaged 63.0 (Table 6). Furthermore, when numbers of fetuses, fawns, and yearlings are each compared to females 2.5 and older the ratio drops substantially with each increase in age class (Table 9). This trend was observed in data from both years. Ratios for the combined data were 178, 94, 42 fetuses, fawns, and yearling to 100 females 2.5 and older, respectively. These data all suggest that from parturition on through the second year of life considerable mortality takes place. The ratio of yearlings to 100 females 2.5 and older probably expresses recruitment better than a fawn:doe ratio. Data from age distribution (Table 5) indicate that, with some variability, females go from the yearling age class to 3.5 to 4.5 years of age without much mortality. Considerable variability in mortality was noted for males past the yearling age class.

Table 9. Comparison of fetal, fawn and yearling ratios to females 2.5 and older for White-tailed deer 1975-76 and 1976-77.

					SAMPLE SIZE		
Time Period	Fetuses: 100 FF 2.5+	Fawns: 100 FF 2.5+	Ylng: 100 FF 2.5+	No. Fetuses/ No. Repr. Tracts Exam. from FF 2.5+	Fawns	Ylng.	FF 2.5+
1975-76	165.4	88.4	27.9	43/26	38	12	43
1976-77	189.4	98.1	52.7	72/38	54	29	55
Combined	177.7	93.8	41.8	115/64	92	41	98

The in-utero sex ratio, statewide for 1976-77, was 157.6 males per 100 females. Sex ratios among fawns and adults in the carcass collection were 100 and 21.6 male:100 females, respectively. These data suggest males suffer a greater mortality rate than females following parturition.

Mule Deer

During the report year 1976-77 data were collected from 75 mule deer carcasses. This was the same number as the year previous even though the period of collection in 1976-77 was about twice as long. About 59 percent of the carcasses were collected between 1 January, 1977 and 31 May, 1977 (Table 10). Ninety-two and 80 percent of the mule deer were collected east of the Divide in 1975-76 and 1976-77, respectively. Road kills accounted for 68 percent of the mortality (Tables 11 and 12). This was similar to 1975-76.

Table 10. Number and percentage distribution by month for collection of 75 mule deer carcasses during 1976-77.

Month	Number	Percentage
January	7	10
February	12	16
March	7	10
April	9	12
May	8	11
June	6	8
July	0	0
August	2	3
September	4	5
October	7	10
November	7	10
December	4	5
Unclassified	2	-

Table 11. Numbers, cause of death and distribution of kill by Administrative Region and statewide for 75 mule deer carcasses found from July 1, 1976 to June 30, 1977.

Region	Cause of Death						
	Road-Kill	Predation	Illegal-Kill	Trap Casualty or Collected	Other	Uncl.	Total
1 & 2	11	1	1	0	0	2	15
3	4	0	1	3	0	0	8
5	10	0	1	0	0	3	14
4, 6, 7	26	1	5	0	3	3	38
Statewide	51	2	8	3	3	8	75

Table 12. Percentage distribution of cause of death by year for mule deer carcasses found from December 1975 through June 30, 1977.

Year	Cause of Death					
	Road-Kill	Predation	Illegal-Kill	Trap Casualty or Collected	Other	Uncl.
1975-76	76	13	-	-	11	-
1976-77	68	3	11	4	4	10
Combined Years	72	8	5	2	8	5

Table 13 shows the distribution of numbers of deer collected by age and sex for each Administrative Region. For carcasses in which age was determined, 31, 18 and 51 percent of the females were fawns, yearling and adults, respectively (Table 14). These figures for males were 50, 25 and 25 percent, respectively. Combined data (Table 14) for both years of the study indicate fawns were the dominant age class followed by the yearling age class. Few males lived past 5 years of age, the oldest being 7.5 years. The oldest female was 12+ years of age. Young:adult and fawn:doe ratios for combined data of each year were relatively high (Table 15). Sample sizes were not sufficient to compare productivity between areas. Again, changes between years in population characteristics may be related more to areas where deer were collected each year than to any actual changes on a statewide basis.

Percent pregnancy, in-utero production and ovulation rates appeared to be quite high in both yearling and 2.5 and older females (Table 16). Neither of the two female fawns examined were pregnant. Both ovulation rates and fetuses to 100 adult females appeared to be higher in 1976-77 than 1975-76. These differences together with the observed difference in the fawn:doe ratios in the carcass collection (Table 15) between 1975-76 and 1976-77 may suggest that 1976-77 was a better year for fawn production and fawn survival than 1975-76. Overall, for both years adult females averaged 1.64 corpora lutea per individual and 150 fawns per 100 individuals (Table 16). As with white-tailed deer, the average in-utero fawn:doe ratio was higher than the average fawn:doe ratio obtained from the carcass collection.

The in-utero sex ratio during 1976-77 was 140 males per 100 females. Among fawns in the carcass collection, sex ratios were 45 and 160 males:100 females for 1975-76 and 1976-77, respectively. For the two years combined the sex ratio in fawns was 83 males per 100 females. For adult deer in the carcass collection the average ratio was 40.0 males to 100 females (Table 15). On an overall basis, these data, together with age distribution data, suggest that males suffer higher mortality rates than females following parturition. However, the variability of sex ratios between years may suggest that such differential mortality is not consistent.

CONCLUSION - DISCUSSION

Though numbers of deer carcasses collected were up for white-tailed deer and the same for mule deer, the rate at which they were collected was down in 1976-77 as compared to 1975-76. The majority of the carcasses for both white-tailed and mule deer were collected in winter and early spring. However, the majority of the white-tailed deer were collected west of the Continental Divide, whereas the majority of the mule deer were collect east of the Divide. Road kills accounted for most of the reported mortality in both species. Fawns were the dominant age class for both white-tailed and mule deer. Females for both white-tailed and mule deer appeared to live longer than males. This fact was largely responsible for male fawns comprising a larger percentage of the male segment than female fawns accounted for in the female segment. Young:adult and fawn:doe ratios were considerably higher for mule deer than for white-tailed deer, though these values were relatively high for both species. Adult females comprised the

Table 13. Number distribution of 75 mule deer carcasses by age, sex and Administrative Region.

	FEMALES							MALES							Combined
	Region						State-wide	Region						State-wide	Statewide
Age	1 & 2	3	4	5	6	7	Total	1 & 2	3	4	5	6	7	Total	
.5			7	1	1	1	10	3	2	5	2		4	16	26
1.5	2		2	2			6	2	2	1	1	1	1	8	14
2.5	2		1			1	4						1	1	5
3.5						1	1	3	1		1			5	6
4.5			2			1	3	1						1	4
5.5	1	1		1		1	4		1					1	5
6.5			1	1			2								2
7.5					1		1								1
8-10	1	1					2								2
11+															
Uncl. Ad.			2	2			4								4
Uncl. Age				1	1		2	1		1				2	4
TOTAL	6	2	15	8	3	5	39	10	6	7	4	1	6	34	73

Uncl. Age & Sex
2

Table 14. Percentage distribution of age by sex and area for 65 assigned age mule deer carcasses in 1976-77 and combined with 63 assigned age carcasses from 1975-76.

Age	West of Divide			East of Divide			East & West Combined		
	FF	MM	Comb.	FF	MM	Comb.	FF	MM	Comb.
.5	0	33	20	37	57	46	31	50	40
1.5	33	23	26	15	26	20	18	25	22
2.5	33	0	13	7	4	6	12	3	8
3.5	0	33	20	4	9	6	3	16	9
4.5	0	11	7	11	0	6	9	3	6
5.5	17	0	7	11	4	8	12	3	8
6.5	0	0	0	7	0	4	6	0	3
7.5	0	0	0	4	0	2	3	0	1
8-10	17	0	7	4	0	2	6	0	3
11+	0	0	0	0	0	0	0	0	0

Combined 1975-76 & 1976-77

	FF	MM	Comb.
.5	37	53	43
1.5	15	22	17
2.5	9	2	6
3.5	5	15	9
4.5	6	4	5
5.5	12	2	9
6.5	4	0	2
7.5	3	2	2
8-12	7	0	5
13+	2	0	2

Table 15. Mule deer carcass numbers, classification, ratios and percentages by area and statewide for 1975-76, 1976-77, and combined.

Year / Area	Numbers					Ratios			Percentages		
	Tot.	Ad.	Yg.	FF	MM	Yg:100 Ad.	Yg:100 FF	MM:100 FF	% Yg.	% FF	% MM
1975-76											
West of Divide	6	3	3	2	1	100.0	150.0	50.0	50	33	17
East of Divide	62	31	31	26	5	100.0	119.2	19.2	50	42	8
Statewide	68	34	34	28	6	100.0	121.4	21.4	50	41	9
1976-77											
West of Divide	15	12	3	6	6	25.0	50.0	100.0	20	40	40
East of Divide	54	31	23	21	10	74.2	109.5	47.6	42	39	19
Statewide	69	43	26	27	16	60.4	96.3	59.2	38	39	23
Combined Years											
West of Divide	21	15	6	8	7	40.0	75.0	87.5	29	38	33
East of Divide	116	62	54	47	15	87.1	114.9	31.9	47	40	13
Statewide	137	77	60	55	22	77.9	109.1	40.0	44	40	16

Table 16. Summary of mule deer reproductive data for 1976-77 together with 1975-76 and combined data.

Year / Age Class	Tot. Deer Exam.	No. Preg.	Litter Size: Sgl.	Litter Size: Twins	Litter Size: Total Fetuses	Sex of Fetus: FF	Sex of Fetus: MM	Sex of Fetus: Uncl.	Percentages: Litter Size: % Preg.	Percentages: Litter Size: % Sgl.	Percentages: Litter Size: % Twins	Percentages: Sex: % FF	Percentages: Sex: % MM	Ratios: Fetuses Preg. FF	Ratios: Corpora Lutea/ Preg. FF	Ratios: Fetuses: 100 FF Examined
1976-77																
.5	2	0	-	-			-	-	0	-	-	-	-	-	-	0
1.5	4	3	0	3	6	4	2	0	75	0	100	67	33	2.00	4.00	150
2.5+	10	10	2	8	18	5	10	3	100	20	80	33	67	1.80	1.80	180
Uncl. Ad.	2	2	1	1	3	1	2	0	100	50	50	33	67	1.50	-	150
Total Ad.	16	15	3	12	27	10	14	3	94	20	80	41	58	1.80	2.00	169
Total Deer	18	15	3	12	27	10	14	3	83	20	80	41	58	1.80	2.00	150
1975-76																
.5	4				4										1.00	100
2.5	14				20										1.45	142
Total Ad.	18				24										1.36	135
Combined																
1.5	8				10										1.75	125
2.5+	24				38										1.62	158
Total Ad.	34				51										1.64	150

largest percentage of the carcasses for white-tailed deer while fawns dominated in mule deer; adult males accounted for the smallest percentage for both species. Percent pregnancy in-utero production and ovulation rates appeared to be well within the ranges reported by Dodds (1963), Verme (1965), Harlow (1965) and Hesselton and Jackson (1968), for white-tailed deer and Robinette (1955 and 1956), Taber (1958), Julander (1961), Nellis (1968), Gill (1972) and Salwasser (1974) for mule deer (Table 17).

No evidence of reabsorbed or mummified fetuses, as reported by Robinette et al. (1955), were found. Loss of ova and/or fetuses in early pregnancy was 17 percent for white-tailed deer and 10 percent for mule deer. Robinette et al. (1955) reported 10.5 percent loss of ova and/or fetuses for female mule deer from conception until death during pregnancy. Robinette (1957) reported loss of ova increased with increase in numbers shed. The difference in loss of ova between white-tailed deer and mule deer in this study was probably related to this.

In general males dominated the in-utero sex ratio and following parturition declined until as adults females dominated. However, the sex ratio obtained for mule deer fawns in 1976-77 was an exception to this generalization. Differential mortality selecting for males has been reported by Taber and Dasmann (1954) and Robinette (1957).

RECOMMENDATIONS

In view of the probable long term nature of this study, plus the problems encountered already in comparing and combining two years of data it is recommended that future tabulation and analysis of data be done by computer. The advantages of using a computer are numerous and clearcut. Tabulation and analysis of data would be standardized. Each year's additional data would be quickly and easily assimilated. Analysis would be more intensive and incorporate statistical tests to lend support to conclusions. A computer would do a much more complete analysis in less time than the present system of analysis. Greater effort on the part of all Department of Fish and Game and cooperating agency personnel to examine and report deer found dead from all non-hunting mortality, especially during the 15 December-15 June period would improve sample sizes and provide increased reliability of data.

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Table 17. Comparative reproductive potential of white-tailed and mule deer from various geographic regions.

Tot. FF Exam.	Percentage % Preg.	% Sgl.	% Twins	% Trip.	Ratios Fetus/ Preg. FF	Corpora Lutea/ FF	Fetuses: 100 FF	Area	Remarks	Source
			WHITE-TAILED DEER							
115	73	47	51	2	1.56	-	114	Nova Scotia	All ages	Dodds, 1963
633	21	-	-	-	1.26	-	27	New York	Fawns	Hesselton & Jackson,
325	90	-	-	-	1.58	-	145	New York	Yearling	1974
559	92	-	-	-	1.84	-	171	New York	2.5+ older	
1,517	62	-	-	-	1.67	-	103	New York	All deer	
									Penned Deer 2.5 and Older	
27	89	8	88	4	1.96	-	174	Michigan	Low nutrition	Verme, 1965
22	86	89	11	0	1.11	-	95	Michigan	High nutrition	
49	88	44	54	2	1.58	-	138	Michigan	Combined	
134	90	75	25	0	1.28	-	115	Florida	1.5+ older	Harlow & Jones, 1965
			MULE DEER							
-		-	-	-	1.67	1.68	150	Montana		Nellis, 1968
-	94	-	-	-	-	1.60	145	California	Shrubland	Taber & Dasman, 1958
-	97	-	-	-	-	.82	71	California	Chaparral	
-	-	-	-	-	1.67	1.64	152	Utah		Robinette et al. 1955
-	-	-	-	-	1.57	-	144	Utah		Robinette 1956
-	100	-	-	-	1.85	1.95	185	Idaho		Julander et al. 1961
-	63	-	-	-	1.33	1.31	119	Utah		
									1.5 and Older	
-	100	-	-	-	1.93	2.02	193	Colorado	Mild winter	Gill 1972
-	88	-	-	-	1.86	1.76	164	Colorado	Severe winter	
-	98	-	-	-	1.64	1.73	161	Colorado	Severe winter	
3	0	-	-	-	-	-	-	California	Fawns	Salwasser 1974
9	100	67	33	0	1.33	1.44	133	California	Yearlings	
46	100	37	59	4	1.67	1.76	167	California	2.5+ older	
55	100	45	54	1	1.62	1.88	162	California	All adults	

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